Upgrade kit OPTIMUS rel. 3.3

4512 104 39893

FILING INSTRUCTIONS

File this documentation in binder: OPTIMUS

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PHILIPS

Philips Medical Systems
Development and Manufacturing Centre

SERVICE MANUAL
742
UNIT

Upgrade Kit OPTIMUS release 3.3

4512 104 39893

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SERVICE MANUAL - UNIT

Upgrade kit OPTIMUS rel. 3.3

Author: A. Duve

Type No: 4512 104 39893

In case there are any questions concerning this manual,
please send this LOPAD via fax to 49/(0)40/5078 2481

File:UK OPTIMUS rel 3.3_a000

List of pages and drawings (LOPAD) **Manual Order No: 4512 984 08482**

0.5	(a/00.0)	223 mm	(Rosa Karton)
1	(a/00.0)		
2	(a/00.0)		
3...16	(a/00.0)		
1... 34	February 29,2000		OM_33_help
2-0.1...0.2	(b/99.0)	[1]	
2-1...45	(b/99.0)	[1]	
6-0.1	(a/98.0)	[1]	
6-1...17	(a/98.0)	[1]	
5Z-1	(99.0)	A3 [1]	
5Z-2	(99.0)	A3 [1]	

[1] OPTIMUS R/F

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*** Note**

*If the generator has been modified with the interims kit **4512 104 39891** Modification kit OPTIMUS release 3 parts of this modification are already done and do not have to be repeated.*
*These chapters are marked with ******

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This modification kit consists of:

- 1 This documentation, includes: 4512 984 08482
  - Software Release 3.3
    as floppy disk, selfextracting 4512 116 02204
    - OMA02204.exe 4512 114 20833
- 1 PROM control desk 4512 113 20524
- 1 system CAN plug adapter EZX43-1 4512 104 90531
- 1 generator CAN termination plug EZX45 4512 104 39901
- 1 wire for high speed rotor control PCB EY100 (versions 4512 108 08701/2)
- 1 capacitor 33nF for PCB mA control 2022 333 00024
- 1 FCO 00 135 006

Tools required:

- low watt soldering iron with fine tip
- PLCC extraction tool, type AMP 822154-1, 2422 487 89772, or equivalent
- flashlight
- standard tools

*** Note**
*If the generator has been modified with the interims kit **4512 104 39891** Modification kit OPTIMUS release 3 parts of this modification are already done and do not have to be repeated.*
*These chapters are marked with ******

Modification:

Attention
When handling PCBs, take all the necessary Electro Static Discharge (ESD) precautions.

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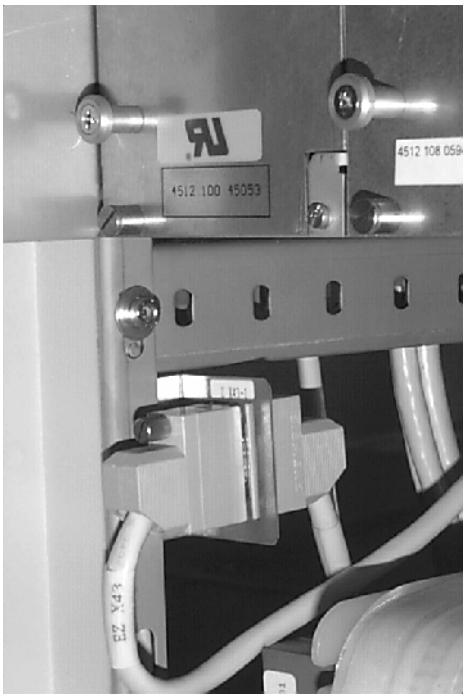
1. Establishing of the system CAN plug adapter

This modification is **only** required at all generators which are connected to a Bucky Controller system via **CAN** bus **EZX43**. (bucky Diagnost TH, easy Diagnost with bucky Diagnost TH, not for Thoravision).

During loading of big data sets from or to the generator (e.g. CU Complete, tube data and APR) there should be no communication with the Bucky or System Controller to ensure a correct and complete loading.

To undo the CAN connection in a more convenient way without removing the generator from the wall establish the adapter EZX43 <--> EZX43-1:

- Remove the system CAN cable from EZX43.
- Fix **EZX43-1** according to the picture at the left frontal side of the generator rack.
- Establish the adapter cable at EZX43.



Note

Whenever big data sets have to be loaded from or to the generator, open the system CAN connection at EZX43-1 before the generator is turned on.
Turn on the generator and wait at least 2 minutes before starting a loading procedure.

Bucky DIAGNOST TH, Thoravision, EZD with Bucky TH

To prevent from unexpected reset commands at the system remove signal bus connection EZX 23 **(a must for Thoravision)** for the following steps.

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2. Saving of generator data

Note

Whenever using XRGSCOPE, start from DOS if possible. Using WIN95 might cause some unexpected problems (WIN 3.x also) depending on the number of multitasking background programs.

XRGSCOPE runs best under pure DOS. If it runs in a DOS - box under WINDOWS 3.x, the file dosprmpt.pif (or possibly a special, self-made xrgscope.pif) should be setted to exclusive and full-screen-mode, which can be done with the PIF-EDITOR.
XRGSCOPE is not tested with WIN95. In case of problems they may be solved if WIN95 is started in MSDOS-MODE.

To ensure safe loading procedures from and to the generator screensavers and any kind of power management must be switched off. These should never be active when using XRGSCOPE.

2.1 Saving of CMOS (CU Complete) and APR data

Download the actual CMOS

Accept - Backup - **CU Complete**, (filename = cu97xxxx.tdl = serial number of generator) to the backup disk in the documentation binder.

If the reading bar turns slowly it might take up to 20 minutes for the CU Complete to be saved on the disk.

Save **APR** with **APRMAN**ager.

If saving of APR is not possible with APRMANager (hangs up), also the individual RGDV APR download via XRGSCOPE is not possible (APRMAN uses the same routines).

In this case proceed to chapter **10.** of this instruction.

Afterwards return to this part and carry out the APR download.

Switch off the generator.

2.2 Error log index

Delete the **Error Log Index** (Faultfind - Logging Table - Error Log - Error Log Clear - <OK>) at the end of the modification.

Please do not send the error log index with the entries before the upgrade.

We always need feedback from the field. Whenever service work or maintenance is carried out next time after the upgrade please

- save the Error Log Index (Faultfind - Logging Table - Error Log - Error Log Index <F3>, filename = er97xxxx.tdl = serial number of generator)

and send the file to:

Carsten Mais, DMC Hamburg, Service Innovation
BBS: carsten mais, node 320/0
e-mail: carsten.mais@de.philips.com
FAX: ..49 40 5078 2348 as hardcopy.

It helps us monitoring the improvement of the Release 3.3 upgrade and what else is going on in the generators.

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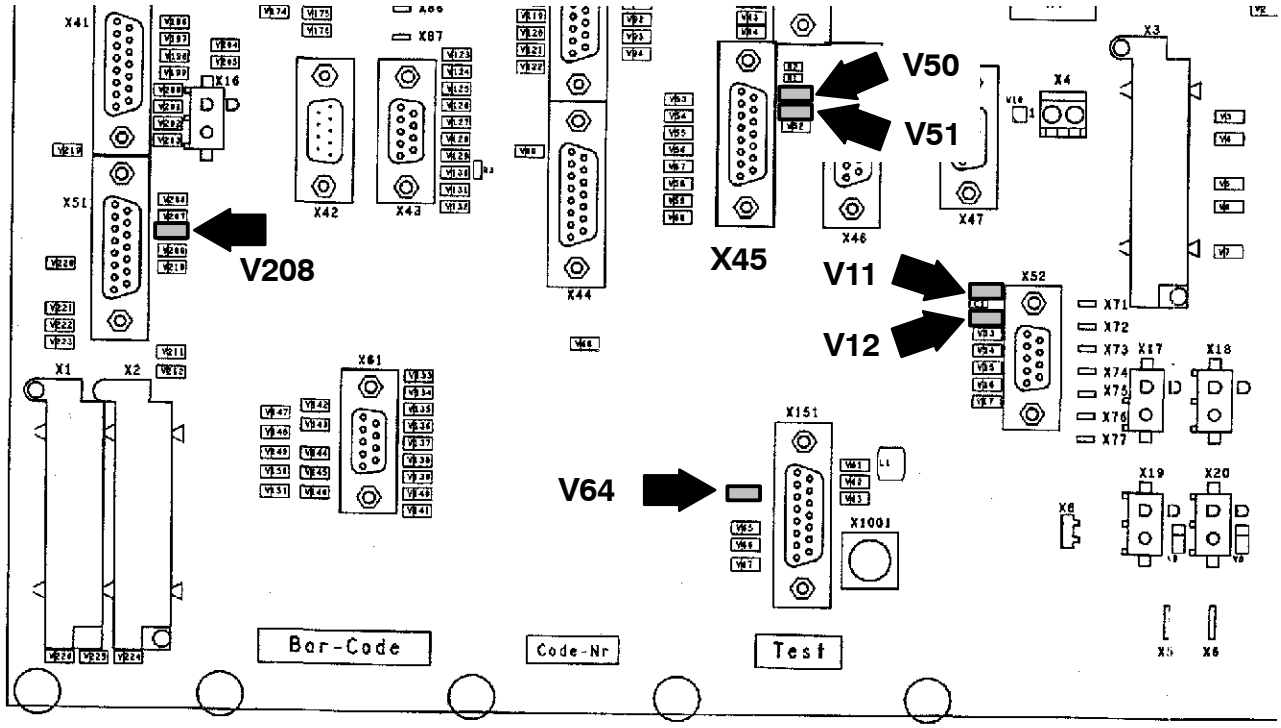
3. Removal of suppressor diodes from internal generator CAN bus *

- Please check on the backpanel if the diodes are already removed.

EZ backpanel version 4512 108 09361



Backpanel 4512 108 09361

334H97

V 11 V 12 V50 V 51 V 64 V 208

If not, discard the diodes.

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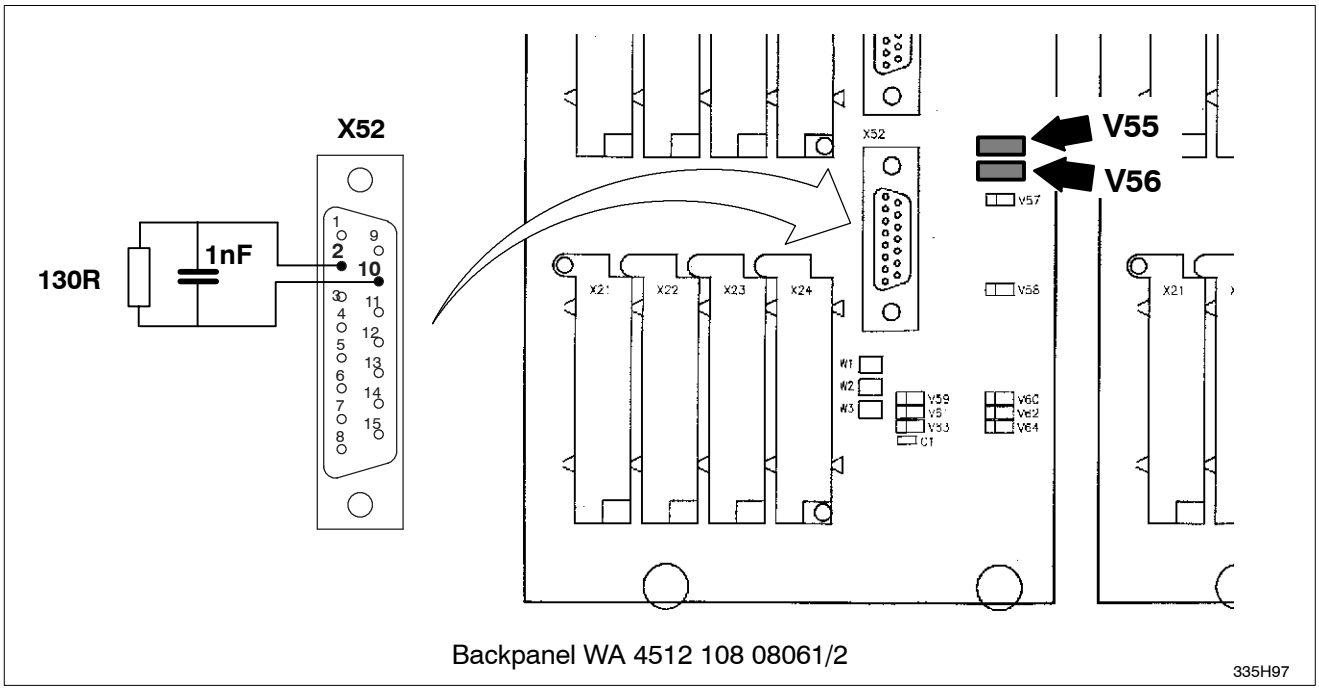
3.1. If option(s) Adapter decade cable WA / WB are installed *

WA or 1WA +2WA (RAD adapter for 4 aux. units) backpanel versions 4512 108 0806**1/2**



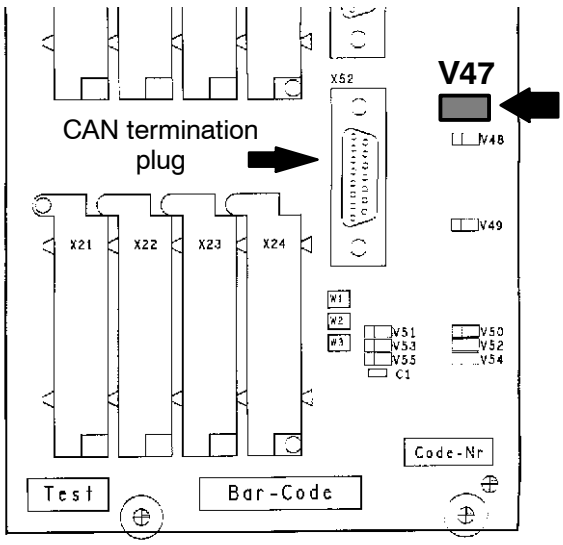
Backpanel WA 4512 108 08061/2

335H97

V 55 V 56

WB (R/F adapter for 4 aux. units) backpanel 4512 108 08082

- Remove and discard diodes WA V55 and V56 and/or WB V47.



Backpanel WB 4512 108 08082

336H97

V 47

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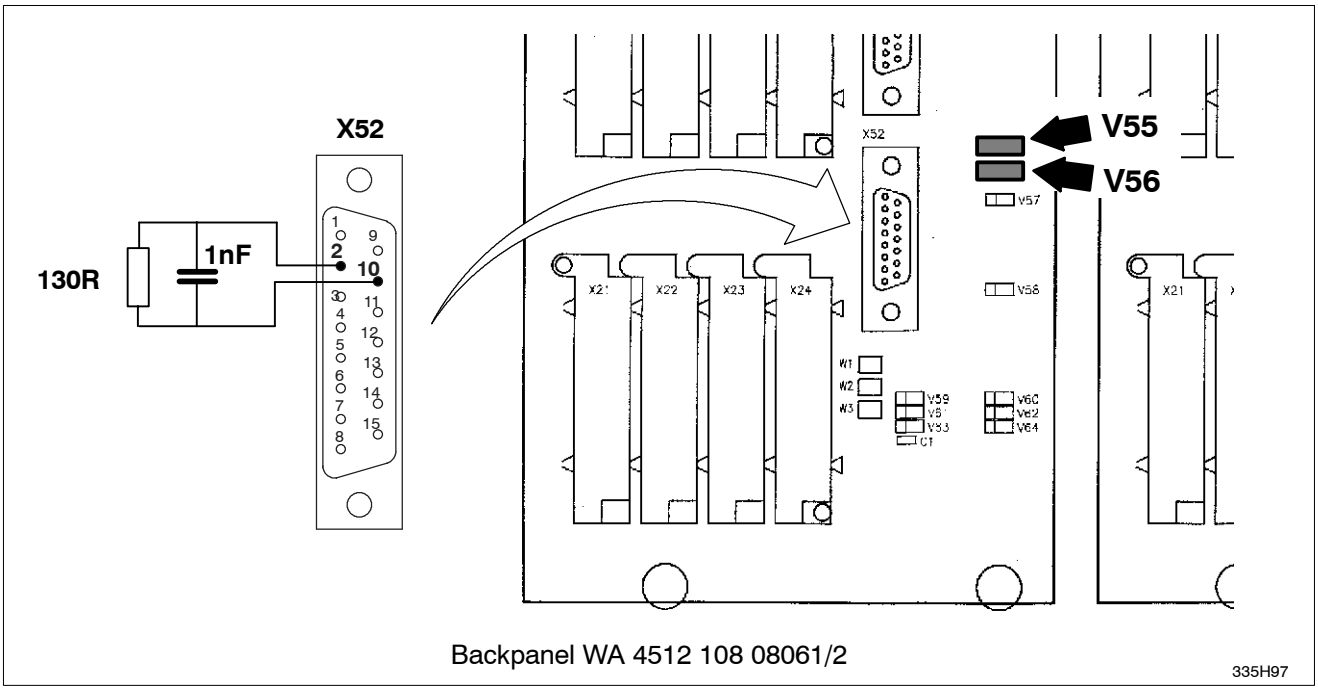
4. Establishing of the CAN termination plug *

4.1. If no WA unit is installed = Bucky Controller or THORAVISION *

- Establish the 15-pin **male** Sub-D termination plug with the RC circuit at **EZX45 (see sketch page 7)**.

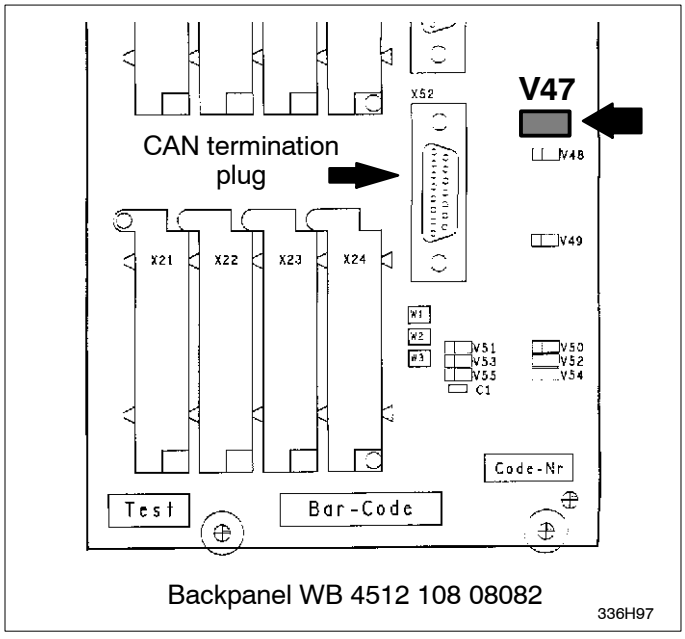
4.2. If WA or WB units are installed *

- Establish the 15-pin **male** Sub-D termination plug with the RC circuit at **WA X52** or **WB X52** or at the free **1/2WA** / **WB X52**.



Backpanel WA 4512 108 08061/2

335H97



Backpanel WB 4512 108 08082

336H97

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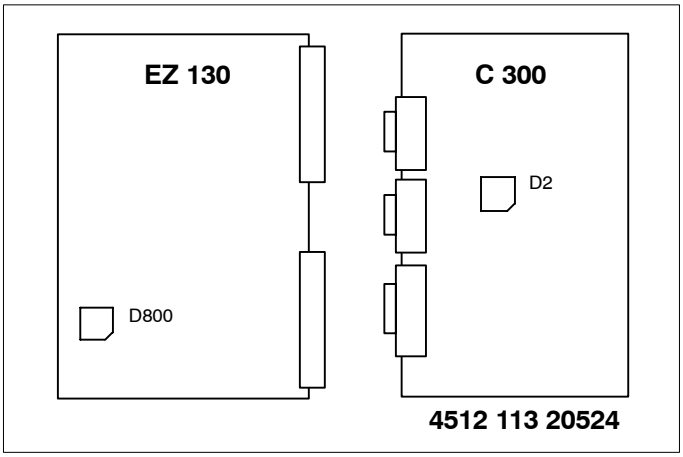
5. Exchange of desk PROM

Exchange the desk PROM C300 D2 by the version attached: 4512 113 20524.



6. Exchange of kV-control PROM *1)*

1. OPTIMUS 50RF (with single converter):
   No action required. The PROM 4512 113 25201 will remain as it is.

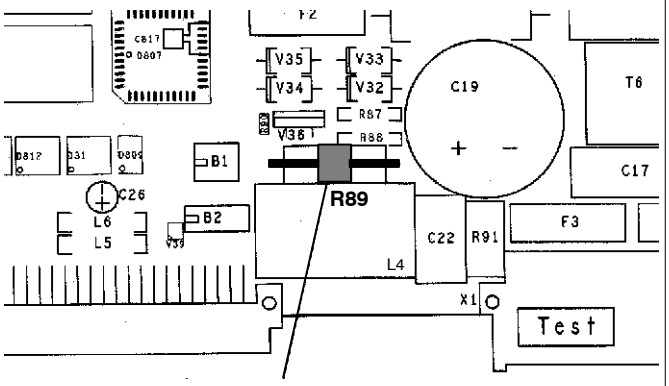
2. OPTIMUS 65/80 RAD and RF:
   The PROM will be exchange by the follow up FCO 00 135 **014**. Please, implement that FCO as as soon as possible.

7. PCB mA_control EZ 119 modification *

To prevent from malfunctions during switch on which may blow fuse F3 on mA-control, a capacitor has to be soldered to the PCB.

The capacitor will be connected parallel to R89. To get it as close as possible to the PCB surface, two soldering points of the choke L4 have to be cut down as short as possible.

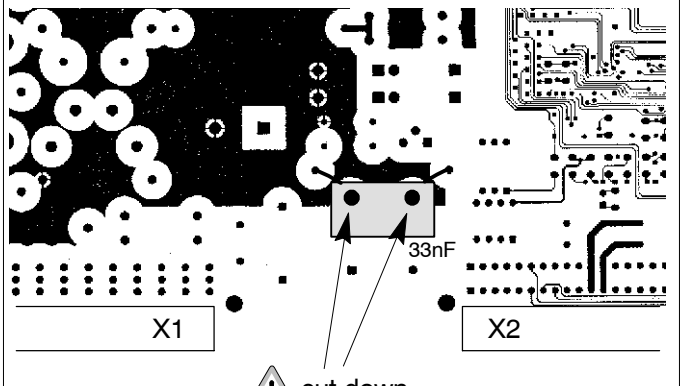
- Solder the capacitor to the points given on sketches.



33nF capacitor parallel to R89 on the soldering side.

EZ 119 part side

344H97



EZ 119 soldering side

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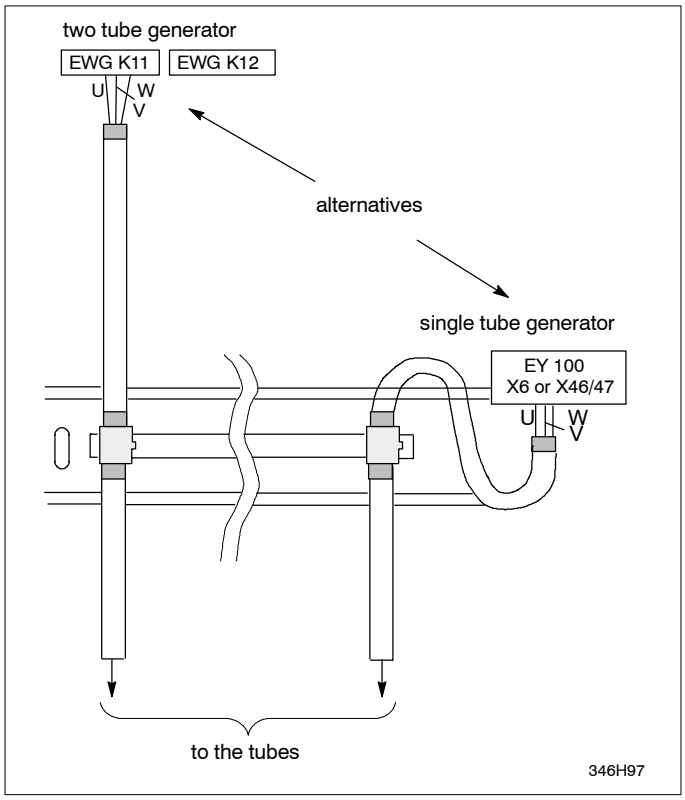
8. Cable routing modification *

The routing of cable overlengths can be optimized.

The stator cable must be shortened to its required length, which means: If it leaves the wall and goes straight to the generator. If the stator cables has to be shortened, it must be mounted according to sketch.



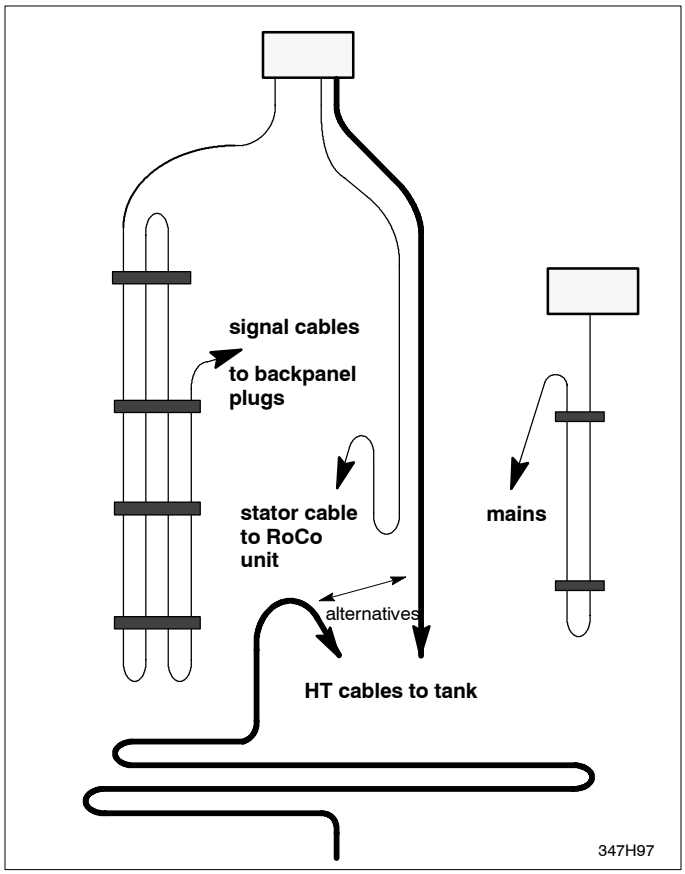
If all overlengths are in the wall junction box, they should be routed up and down or left and right and tied up in a closed loop according to sketch.

Try to separate
- signal
- mains and
- HT + stator cables

in the wall junction box..

The minimum bending radius must be 5 cm / 2 inch for 16.5 and 20 mm HT cables
and
7cm / 3 inch for 23 mm HT tables.

Always avoid open loops.



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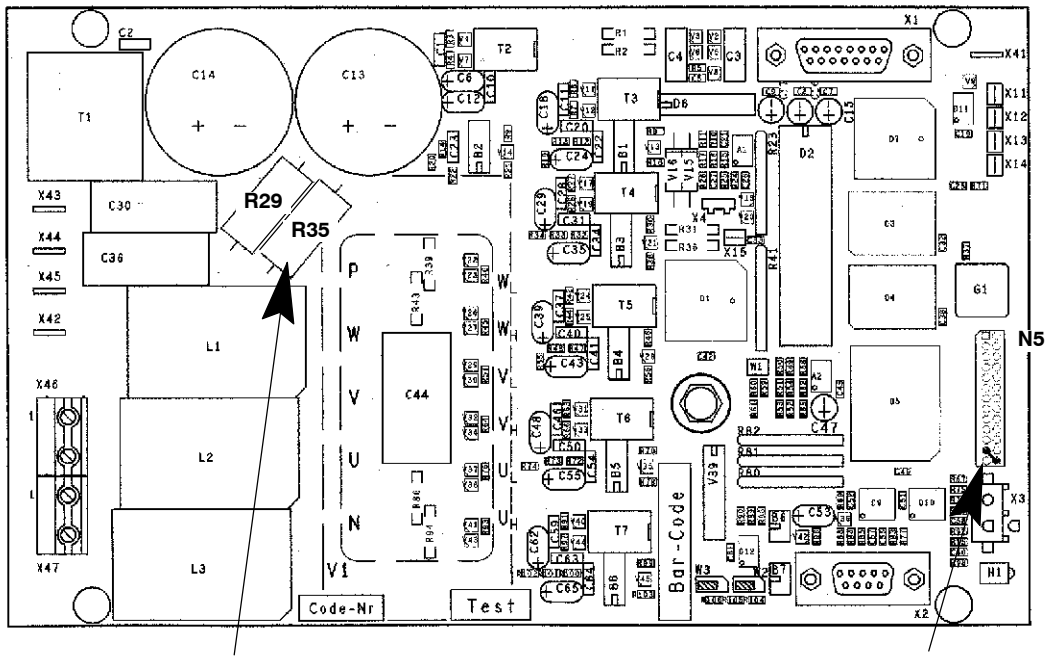
9. High Speed Rotor Control modification (= FCO 00 135 004)

Modification of the PCB High Speed Rotor Control EY 100 versions 4512 108 08701/2.

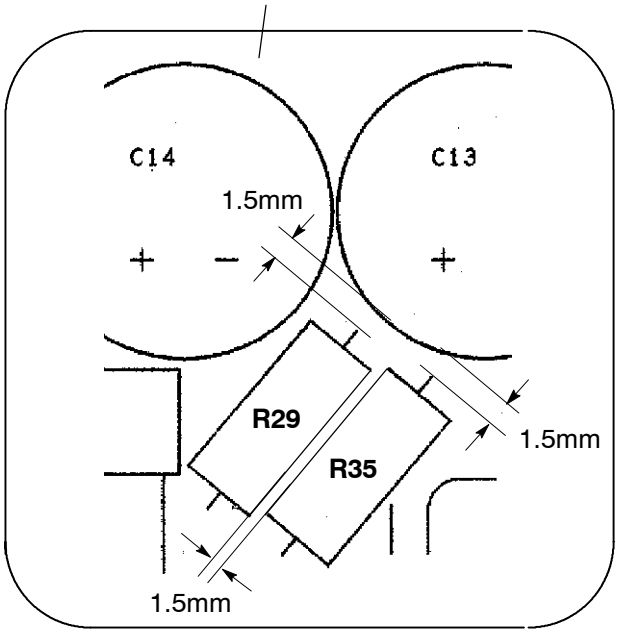
The processor on the rotor control has a debug port. One of the signals is not connected to a pull up resistor. The floating signal leads to the error combination 00XI + 00M3. It happens only once during turn on, not during normal operation.

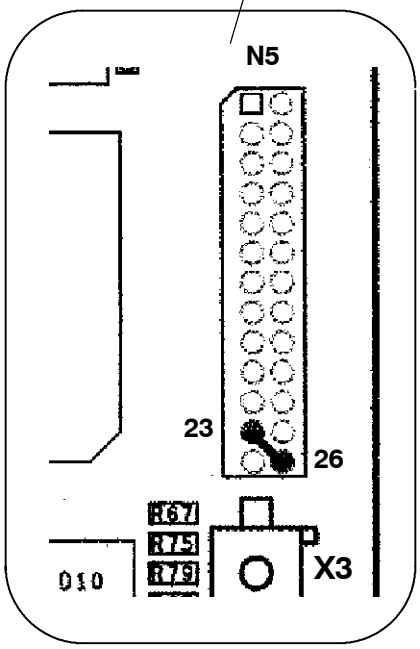
- Solder a link between N5:23 and N5:26 of the EY 100 PCB, see sketches.
- Remove plug X3, which gives an easier access to the points.

4512 108 08701/2



Check that the connnecting wires of resistors R29 / R35 have a distance of at least **1.5 mm** to the capacitors C13 and C14. Also between the resistors itself a gap of **1.5 mm** is necessary, see sketch.
When the resistors come in contact to the capacitors or have mechanically contact to each other this can lead to a shortcircuit and defect of the rotor control.





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10. Loading of Release 3.3 firmware to the flash PROMs on CU EZ 139

10.1. Unpacking of the installation disc data files

There is one disk with the upgrade kit. It has one selfextracting **OMA02203.EXE** file. The content of the packed .EXE file is listed in the OMA02203.TXT file attached.

A free hard disk space of 5 MB is required.

Create a new directory on the PC harddisk (e.g. C:\OPT_R_33) and load the file of the installation disk into the new DIR (copy A:*.* C:\OPT_R_33). Run the .EXE file to inflate the programs.

In case of any damage of the disk or the files OMA02203.EXE is always available on BBS.

10.2. Loading of Release 3.3 to the Flash PROMs

The generator should still be off and **must be off** when starting the loading process.

The system CAN connection EZX43-1 or EZX43, if APR download did not work (and the signal bus EZX23, Thoravision only) must **not** be established.

- Establish the data cable PC (COM1 or COM2) <<>> generator CU EZ139 X5.
- Start (from DIR OPT_R_33) either program

FLASH1.BAT (using serial port COM1)

or

FLASH2.BAT (using serial port COM2).

- Wait, until PC displays:

Attempting link to device

- Switch on the generator.

Now the firmware will be loaded automatically to the Flash-PROMs on CU EZ139. It takes 15...50 minutes depending on the processor type of the PC.

At the end of the loading procedure (100%) one has to wait until the message

Flash loaded OK
<OK>

comes up.

It might take up to 10 minutes before the message appears !!

- After typing <Return> the PC will display a command line.

Restart normal

The LEDs on the FU's will keep blinking for a while after a certain time they will stop. After some more seconds also CU stops blinking.

- The normal communication to the generator can be started now.

If the time between 'Flash Loaded <OK>' and pushing of <Return> on the PC takes too long <ESC> has to be pushed once or twice on the PC.

If an original CMOS still exists, the control desk will come up as usual with the parameters and settings when the generator has been switched off.

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10.3. Release and level check

To confirm the loading of R 3.3 check the screen

Faultfind >> Power ON Results >> SW/HW Versions.

Use only columns R and L (release and level, V = version is always 1).

CU APPL SW: must show R3V1L3 after loading

FU kV:
- must show R3V1L1 for all RAD generators and all OPTIMUS R/F with two converters.
- must show R0V1L1 for all R/F 50kW generators with one converter only (no exchange of PROM EZ 130 D800).

FU HIa: must show R2V1L4

All others according to the generator configuration.

If APR download has not been successful before loading of firmware rel 3.3, go back to chapter 2.1 now.

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11. Readaptation of the tube(s)

Warning!
Radiation is released during the following procedure.

To avoid warning entries 03PB (emission current out of range) in future, the tube(s) must to be readapted.

OPTIMUS RAD generators with release circuit adaptation units **1/2WA**

and

OPTIMUS R/F generators with release circuit adaptation unit **1WB (and 1WA)**

should use the free cassette RGDV without sync contact for adaptation.

Bucky Diagnost TH and **easy Diagnost with bucky Diagnost TH** via system **CAN:**

- Switch off the generator.
- Reinsert the system CAN cable at EZX43-1.
- Switch on. Select free cassette RGDV.

Thoravision:

- Switch off the generator.
- Reinsert the signal bus cable at EZX23 and the system CAN cable at EZX43-1.
- Switch on. Select RGDV2 free cassette and position the tube safely, so that the selenium drum is not in the X-ray beam.

Carry out adaptation of all filaments according to the generator book **INSTALLATION**
chapter **10.2 Adaptation of the tube**.

- **Restart Thoravision.**

If the generator had warning entries **03PB** in the **error log index** and the generator has been programmed to single boost mode, change

- Program - Tubes - Tube Operating Modes - **intermediate boost: disable** setting to **enable**.

12. Functional tests

- Does the generator come up as before the upgrade ?
- Check menu / APR settings, Film-Screen-Combination assignments.
- **Bucky Diagnost TH** systems and **Easy Diagnost with Bucky Diagnost TH** systems **via CAN**: Does the control handle work as before and is the selection of the preferred APR from the control handle still the same ?
- **R/F tables:** Is the selection of the Scopomat APR still the same ?
- Switch exposures , use all available techniques (AEC, AEC fixed current, TDC, kV-mAs, kV-mAs-ms, kV-mA-ms)
- Test fluoroscopy (where available).

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13. Notes and hints

- If the customer can not save overridden APR (Program – Human Interface – APR modifiable by User – APRs are modifiable = **no**) one might see a confusing effect in combination with a BuckyTH via Bucky controller:

– When carrying out the save function (first push and hold the RESET button, then push the overridden APR) the generator desk jumps to the APR, which is assigned to **APR Program 1** at the control handle of BDTH for the selected RGDV.

Ignore for RAD sites without Bucky controller and Thoravision.

- **!!** Generators with systems via Bucky controller EZX43 (BDTH, EZDiagnost if with BuCo, Thoravision):

Never use function– Program – Tubes – Disable Tube –

to delete the tube being associated to the Bucky controller RGDV's. Once this function is started the generator is dead. The battery jumper EZ139 W1 has to be set to position 2–3 to erase the CMOS. Then after 5 minutes set the jumper back to position 1–2 = Batt. on. Load CU Complete or program the generator from the very beginning.
Before disabling the tube set **Bucky Controller 1** to **none** in ***RGDV1...4 Data Set A***.

14. Documentation

File this FCO instruction under Tab 8 SERVICE INFORMATION in the Service Manual binder.
Replace documentation chapters
INSTALLATION
PROGRAMMINGS
ADJUSTMENTS.
Replace installation disk.

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O P T I M U S RAD + R/F GENERATOR
R e l e a s e 3.3 with XRGSCOPE 3.14 (PC version)

This HELP-manual is in the order of the screens and commands coming up if XRGSCOPE is started on the service PC. It explains the functions and modes in the order of their appearance and explains all functions including the ones which can only be accessed with the PC hardkey, indicated with >hardkey<.
They are indicated in chapter FAULTFINDING of the SERVICE MANUAL (generator documentation = doc).

XRGSCOPE 3.14 can be used for Optimus generators release 3.3 and 2.3 with one exception for tube programming: Release 3 generators must use the TUBE_R3.TDL file, release 2 generators TUBE_R2.TDL. Previous releases (0.2 / 0.3 / 1.1 / 2.1 / 2.2 / 3.2) are no longer supported.

Text explanations in *'italic letters and quotation marks'* refer to **bold and underlined** screen or item names.

Some **bold and underlined** screen names have red FILE NAMES added. These files have been saved with <F3> online with a generator. To open the files call XRGSCOPE, push <ESC> when it says "Attempting link to device ...", then use "File" and select the file name mentioned. It allows to program the screen within its limits and selectable items as if one is online with the generator.

Note:
Whenever using XRGSCOPE, start from DOS if possible. Using WIN95/98 might cause some unexpected problems (WIN3.x also) depending on the number of multitasking background programs.
XRGSCOPE runs best under pure DOS. If it runs in a DOS-box under WIN 3.x, the file dosprmpt.pif (or possibly a special selfmade xrgscope.pif) should be setted to exclusive and full-screen-mode, which can be done with the PIF-EDITOR.
XRGSCOPE is not tested with WIN95/98. In case of problems they may be solved if WIN95/98 is started in MSDOS-MODE.
WIN NT requires special drivers to get access to the PC hardkey, available on the customer support CD-ROM 2422 210 42202.
To ensure safe loading procedures from and to the generator screensavers and any kind of power management must be switched off. These should never be active when using XRGSCOPE.
Do not start XRGSCOPE or FLASH1/2 with NORTON, some loading process might take hours !

Unpacking of the installation disk data files

There are two disks with the documentation. Each disk has a selfextracting **OMA0220x.EXE** and **OMB0230x.EXE** file. The contents of the packed.EXE files are listed in the OMA/OMBxxxx.TXT files attached. A free disk space of 5 MB is required.
Create a directory on the PC harddisk (e.g. C:\OPT_R33) and load all files of both installation disks into the new DIR (copy A:*.* C:\OPT_R33). Run both .EXE files to inflate the programs.
Note! Since OMA 02204.EXE a new tube firmware TUBE_R3.TDL exists to drive the new version of rotor control 4512 104 71421 or 4512 104 71461 with firmware 4512 113 22322. It also runs on all predecessor rotor controls 4512 104 71401...6 with firmware 4512 113 22312.

Loading of the Release 3.3 firmware to the Flash PROMs on CU EZ139

Generators (preinstalled or as replacement) and spare CU-PCBs are always delivered with Release 3.3.

Just in case release 3.3 is not loaded in the flash-PROMs it has to be loaded first. Afterwards the generator can be programmed:

- Switch off the generator.
- Select the DIR with release 3.3 XRGSCOPE files.
- Establish the data cable PC (COM1 or 2) <<>> generator CU EZ139 X5.
- Start either program
  FLASH1.BAT (COM1) or
  FLASH2.BAT (COM2).
- Wait, until PC displays:

Attempting link to device

- Switch on the generator.

Now the firmware will be loaded automatically to the Flash-PROMs on CU EZ139. It takes 15...50 minutes depending on the processor type of the PC.

- !! After the end of the loading procedure (100%) one must wait until the message

Flash Loaded
<OK>

comes up.
It might take up to 10 minutes before the message appears !!
After typing <Return> the PC will display a command line

Restart normal.

The normal communication (e.g. to run the seeting to work) to the generator can be started now.

If the time between 'Flash Loaded <OK>' and pushing of <Return> on the PC takes too long <ESC> has to be pushed once or twice on the PC.

If an original CMOS still exists, the control desk will come up as usual with the parameters and settings when the generator has been switched off.

If nothing has been programmed or if e.g. the mA_control PCB has been exchanged and no tube has yet been programmed, the control desk will only display PHILIPS OPTIMUS and dots will fill all APR segments. Then the generator has to be programmed according to the local configuration.

File

Whenever XRGSCOPE is started, the program will first of all display the screen CUSTOMER.TDL (with what is actually stored in CUSTOMER.TDL, details see *'Customer Data'*). The default screen is empty.
Note: During every log-in an entry **00S*** will appear in the error log index to indicate service access to the generator (including APRMANager). To prevent from getting too many 00S* entries one can leave XRGSCOPE active on the PC and turn the generator off. After turn-on the communication generator starts at the same screen which is open on the PC (even if the communication cable has been removed when the generator was off).

- **Open Data File**

  Allows to open data files of the current DIR from which XRGSCOPE has been started. Files can be opened and the content can be displayed. Some files might be too big to be displayed, then a screen **table too big** will come up. It depends on the free DOS memory and the file size.
  To enter in the file list push the <TAB> button and select with the cursor buttons or type in the file name. If xxx.TDL files shall be displayed from a floppy disk, just type **A:** in the command line and the file list will be displayed. *'Open Data File'* can also be used offline.

- **Start Macro Recording = Alt+R** Of no practical use for programming or troubleshooting, to be continued.

- **Execute Macro = Alt+E** Of no practical use for programming or troubleshooting, to be continued.

- **Load Macro = Alt+L** Of no practical use for programming or troubleshooting, to be continued.

- **Save Macro = Alt+W** Of no practical use for programming or troubleshooting, to be continued.

- **Customer Data** CUSTOMER

  Whenever data screens like *'error log index'* are saved to a xxx.TDL file (function **Save: <F3>** appears in the bottom line), *'customer data'* being saved in the CUSTOMER.TDL file are attached to the saved data screen. It helps to separate saved screen files of different sites, customers or rooms in the same hospital. Site data must be stored in CUSTOMER.TDL file, only data of this file are attached to the saved screens. One can save site specific customer data in self-made files using <F3>. To recall site data use the **Load: <F4>** function. **<F4>** does not appear in the bottom command line, but it is possible to use it.
  Procedure: Either the CUSTOMER.TDL screen is open or open the *'Customer Data'* screen. Push <F4> and select a site data file. The old data screen comes up. Now save this screen with <F3> typing in CUSTOMER as file name.

  - **Customer Name:**
  - **City / State:**
  - **Country:**
  - **Generator Location:**
  - **Generator Serial Number:**
  - **Generator 12 NC:**
  - **Memo1:**
  - **Memo2:**
  - **Memo3:**

- **Exit Program = Alt+X**

  To leave XRGSCOPE back to DOS (or WINxx).

Optimus (XRG90) >> Program

Notes:
Several screens, once transmitted with <F2>, are followed by a screen

Message from Device:
Before continuing the generator must be reset !
<OK>

It is advisable to reset the generator whenever the screen says so. Then one can be sure to get the full funcionality of the generator.
If a generator has to be programmed from scratch one can program as many steps in a row as necessary and make one reset at the end of the programming procedure. It saves a lot of time.
If only a change of a programming screen takes place (e.g. 'RGDV x Data Set A') it would be sufficient to push the RGDV button at the control desk after Transmit <F2> to validate the modified data.

A down-pointing arrow at the end of a programming line allows a selection of values or options after pushing <ENTER>. Select items with the cursor and push <ENTER> or <F2>.

[*Square bracket* **]** *fields allow to enter values within a given range. If the entered value is out of range the limits will automatically be displayed. Value fields without brackets can not be changed, for reading only.*

- **Date and Time** must to be programmed
  - with a new CU PCB DATETIME
  - after CMOS erase (battery off)

- **Mains data** MAINS
  - **U_mains_nominal [V]** available values= 380 / 400 / 440 / 460 / 480 V
    default value = 400V
    (for 415V select 400V)
  - **Ri_mains [mOhms]** range of mains resistance = 0...500 mOhms
    default values: 50kW = 200 mOhms
    65kW = 100 mOhms
    80kW = 100 mOhms

!! It is important to select (U) and type in [Ri] the true values. The calculation of the
!! kV_control for the duty cycle to drive the IGBT's is based on that.

Power reduction table:

			380V	400V	440V	460V	480V
Ri for	<	300mOhms	50kW	50kW	50kW	50kW	50kW
Optimus	<	350mOhms	40kW	50kW	50kW	50kW	50kW
50kW	<	400mOhms	30kW	40kW	50kW	50kW	50kW
Single	<	450mOhms	30kW	30kW	40kW	40kW	40kW
Converter		500mOhms	30kW	30kW	30kW	30kW	30kW
Ri for	<	150mOhms	100kW	100kW	100kW	100kW	100kW
Optimus	<	200mOhms	80kW	80kW	100kW	100kW	100kW
65/80kW	<	250mOhms	65kW	65kW	80kW	80kW	80kW
Double	<	300mOhms	50kW	65kW	65kW	65kW	80kW
Converter	<	350mOhms	40kW	50kW	50kW	50kW	65kW
	<	400mOhms	30kW	40kW	50kW	40kW	50kW
	<	450mOhms	30kW	30kW	40kW	30kW	40kW
		500mOhms	30kW	30kW	30kW	30kW	30kW

The max kW limit and with it the max mA is programmed in the function key EZ139 D38 (depending on the customer order, see STAMMKARTE on frontal kV power unit).

- **Tubes**

  - **Tube 1**...3

    - **Tube 1**...3 **Data Set**

      Note! Since OMA 02204.EXE a new tube firmware TUBE_R3.TDL exists to drive the new version of rotor control 4512 104 71421 or 4512 104 71461 with rotor control firmware 4512 113 22322.
      It also runs on all predecessor rotor controls 4512 104 71401...6 with rotor control firmware 4512 113 22312.

      After 35 sec of **Reading** (spinning bar) the screen **Load Data from Disk** comes up, offering the default **TUBE_R3.TDL**. file

      With <OK> a screen **Availabe Tubes (Rel.3 Format)** offers a selection of all available tubes in non-cooled housings ROT350 (250W) or water cooled housings ROT351 (500W).
      After tube selection a screen **Analysing** will come up, followed by **Transmitting** and then **Percent transmitted** (how much of file has ben loaded to the generator). Wait until the PC comes up with the message to reset the generator:

      D O N O T R E S E T B E F O R E !!

      !! In case of a single focus tube like RO30: APR's loaded to a RGDV with this tube
      !! connected should only be programmed on the **large** focus (use APRMANager).

    - **Tube 1**...3 **Speed Selection** range = 3000...9000 rpm TUBESPEE

      - Exposure rotation [RPM]:
      - Fast Exposure rotation [RPM]: (fast exposure not applicable for Optimus R/F)
      - Fluoroscopy rotation [RPM]: fluoroscopy without rotation is not possible

      The speed for the tube type and technique is automatically taken from the tube data file. Fluoroscopy without rotation is not possible.

      !! **All** stators have to be connected as an SRO tube, see doc INSTALLATION **!!**
      For special tubes see doc INSTALLATION.

  - **Tube Limits** (only **[value]** fields can be modified) TUBLIMIT

    Tube: 1 ... 3

    Max. Tube Voltage Limit [kV]: range: **[20...150]** kV

    The value must be programmed according to the max kV of the tube (see tube label). If a tube arcs during adaptation the max kV value can be reduced (or repeat the break in procedure, see doc INSTALLATION). After adaptation the programmed value is the max value which can be selected at the control desk (the adaptation table has no values beyond the limit kV value), even if a higher value is programmed thereafter in this field. The kV value with which the tube has successfully been adapted appears in *'Adapted To [kV]:'*.
    If a tube has been adapted with a higher kV than it should be used for (e.g. max 100kV for veterinary surgeons) the limit must be programmed in this data field afterwards.

    Focus: **small**, **middle**, **large**

    The middle focus would be a third physical filament in a tube (not yet available), it is **not** the VARIO focus.

Min. Tube Voltage Limit [kV]: range: **[20...150]** kV

All standard diagnostic tubes of the TUBE_R3.TDL tube file have a default min kV value of 40 kV, it can only be modified in a range > 40kV.

Adapted To [kV]: gives the max available kV value at the control desk (after adaptation)

If this value shall be increased, first the *'Max Tube Voltage Limit [kV]:'* must be increased first. Then the tube has to be readapted afterwards to have the higher kV available for application.

Min. Tube Current Limit [mA]: range: **[0.1 ... 2000]** mA

0.1 mA is the lowest current of the Optimus (fluoroscopy and TDC only).
The lowest mA value one can select at the control desk for exposures is 1 mA.

Max. Tube Current Limit [mA]: range: **[0.1 ... 2000]** mA

The kV dependent max mA value is automatically limited by the tube type **and** the generator version:
OM 50 kW max = 650 mA OM 65 kW max = 900 mA OM 80 kW max = 1100 mA

The max tube mA value is initially set by the tube data set of the tube file and can not be increased. It will be adapted to the individual focus limits during adaptation (within the total tube limits), the max mA table can be seen in *'Select Unit' >> 'FU_mA' >>'Programming'*.
!! If there is any applicational reason to decrease the max mA value it is possible, but it will
!! influence all registration devices attached to this tube and might lead to problems, if
!! additional reductions of the emission current and tube power are programmed in the
!! individual *'APR Data Set*'s and/or in *'RGDV Data Set B'*.

- **Capacitance Tube Connection** - formula and table = see doc INSTALLATION CABLECAP

  - **Tube 1** ... 3 **Capacitance on Tube Connection [nF]:**

    range = 2.000nF - 10.000nF, a value of approximately 5.300 nF should never be increased to prevent damages during tube arcing.

- **Tube Operating Modes** TU_OP_MO

  - **intermediate boost:** (intermediate boost explanation see doc FAULTFINDING function unit FU_mA)

    enable = double boost mode active (default)

    Active, if emission current in a range of **[**Ie max - 20%**] ... [**Ie max**]**
    Inactive, if emission current < **[**Ie max - 20%**]**
    and if *'single step'* has been programmed at 'E*xposure switch type'* at 'D*ata Set A'* .

    Recommended for **childrens** hospitals and **casualty** rooms (long preparation times).

    disable = single boost mode

  - **rotation prolongation after prep:** **!!** Only possible with HIGH SPEED rotor control units **!!**

    disable = (default)
    Anode stops immediately after exposure end or let go of the PREP handswitch if PREP has been started from standstill.
    enable = Once started with PREP from standstill the tube keeps rotating for 30 seconds after the last let go of the PREP position as long as no exposure has been switched.
    The tube finally stops if an exposure has been switched (or after 30 sec).

Recommended for **childrens** hospitals and **casualty** rooms.

- For exposure series, if *'Exposure series / Tomo movement'* = yes has been programmed at RGDV *'Data Set A'.*
  Exposure series have to be started with a fluoro command, afterwards the tube keeps 9000rpm exposure speed for 30 seconds after the last prep or fluoro.

- **Disable Tube**

  - If a tube (e.g. 2nd tube) shall be removed from a system one should use this function. If a tube shall be removed temporarily one should do it at the registration device *'RGDV1...8 Data Set A'*.

  !! In combination with *'Bucky Controller 1'*: **DO NOT** use this function before all RGDV associated

  !! to *'Bucky Controller 1'* have been changed to *'none'* instead of *'Bucky Controller 1'*.

  - This function **must** be used if a double focus tube shall be replaced by a single focus tube. The non-used small filament circuit of FU_mA must be switched off.
  - If a double focus tube shall be replaced by any other type, it is not required to disable the tube. Just load the other tube type according to *'Tube 1...3 Data Set'*.

- **Registration Devices**

  - **RGDV 1** ... 8

    - **RGDV 1**...8 **Data Set A** RGDV_A1

      - **Room:** **Room 1**...3 for room door contact and radiation warning lamp wiring see doc INSTALLATION

        - to switch over - room door contacts (where available)
          - radiation warning lamps

        - indication for PDO (patient data organizer) option prints

      - **Tube:** **None** RGDV not availabe, *'None'* can be used to disable a RGDV selection without erasing the tube data in mA_control and CU

        Tube 1...3 a tube must be programmed to activate a RGDV

      - **Release circuit number:** **Circuit 1** ... 4

        - one out of four release circuits of a *'Release circuit adaptation unit'* 1WA, 2WA, 1WB, (2WB not yet available)
          (e.g. Adapter for 4 aux. units WA: 1 = EWAX1 2 = EWAX2 3 = EWAX3 4 = EWAX4)
        - **ignore** in case of a *'Bucky controller 1'* or *'Thorav. / Dig. Bucky'*
        - **ignore**, if *'none'* is programmed for a *'Release circuit adaptation unit'* (e.g. free cassette RGDV without cassette present interlock)

        RGDV number and *'Release circuit number'* **do not** have to be the same, (e.g. all 8 RGDV's can be programmed to one release circuit only)

- **Enable handswitch at generator desk:**

  yes = release with the desk handswitch **and** via release decade of WA or WB possible

  'yes' **must** be programmed in combination with *'Bucky Controller 1'* or *'Thorav. / Dig. Bucky'*

  no = release via the programmed decade of WA or WB **only** (*'Release circuit number'*)

  'no' **must not** be programmed in combination with *'Bucky Controller 1'* or *'Thorav. / Dig. Bucky'*

- **Syncmaster present (e.g. grid contact):**

  yes = has to be programmed in case of

  - *'Release circuit adaptation unit'*s (WA/WB):
    - grid synchronisation (20-21) decades X1...X4 pins 1-2
    - ditto tomo release (exposure request of layer angle), dec. X1...X4 pins 1-2
    - if cassette present interlock (free cassette) does not use a ready circuit but this sync contact, decades X1...X4 pins 1-2
    - BuckyTH, BuckyTH2, Bucky unit of easyD, Digital Bucky via CAN for grid sync, tomo release synchronisation **and** free cassette, release via signalbus EZX23 CTRL_X/ **(FCO: BuckyTH 00 231 007, easyD 00 263 009)**
    - Thoravision RGDV1 (drum) **and** RGDV2 free cassette, via signalbus EZX23

  no =
  - in case of free cassette RGDV's, no release decade required (then no link has to be inserted to any of the four release decades pin 1-2 (20-21) of the adaptation units WA/WB, the free decade can be used for another auxilary)
  - **must not** be programmed for BuckyTH, BuckyTH2, Bucky unit of easyD, Digital Bucky and Thoravision CAN
  - must be **no** for adaptation at BuckyTH2, Bucky unit at easyDiagnost with BuCo firmware 5.x, Digital Bucky, complete setting see *'Adaptation'*

- **Exposure switch type:**

  double step = individual PREP and EXPOSURE request with the desk handswitch or via the release decades of WA/WB

  - **must** be programmed if *'Exposure series / Tomo movement'* = *'yes'*
  - **must** be programmed for BuckyTH, BuckyTH2, Bucky unit of easyD, Thoravision and Digital Bucky via CAN

  single step = instant EXPOSURE request with PREP activation only, released from

  - the desk handswitch or
  - a release decade at WA/WB or
  - the PREP switch S2 of a *'Release circuit adaptation unit'* WA/WB

  Does **not** work **without** *'Release circuit adaptation unit'* WA/WB.

  - **must not** be programmed if *'Exposure series / Tomo movement'* = *'yes'*
  - **must not** be programmed for BuckyTH, BuckyTH2, Bucky unit of easyD, Thoravision and Digital Bucky via CAN

  !! If *'intermediate boost'* mode has been *'enable'*d to activate double boost mode, it will automatically be off if *'single step'* is programmed.

- **Bucky format density correction (6% steps):** range = - 8 ... + 8 steps see **[1] page 24**

  - correction during collimation, input at WAX11/12 pin 1-2 or WBX11 pin 1-2, sidefields active when contact closed (>24x24cm), center field only when open

  - with GALILEO collimator Bucky Controller, Thoravision or Digital Bucky ask application

- **Cone density correction (6% steps):** range = - 8 ... + 8 steps see **[1] page 24**

  - correction when cone in use, input at WB X13 pin 4-5, active when closed, Optimus R/F only

- **Dose measurement input:**

  none = - **no AEC / AECF / TDC ***** function available
  - **EZX61** in use for dose rate inputs, in this case the **exposure on** signal X_ACT/ has to be connected to the central part via signal bus

  EZX21 = chamber 1\
  EZX22 = chamber 2 \ to be used for
  EZX31 = chamber 3 >backpanel input plugs **Amplimat** and/or
  EZX32 = chamber 4 / **R/F photo sensor input**
  EZX41 = chamber 5 / (R/F (e.g.DSI) EZX41 preferred)

  ***** AEC** = **A**utomatic **E**xposure **C**ontrol (option) = Amplimat falling load
  AECF = **AEC F**ixed current (if AEC option present) = Amplimat kV - mA
  TDC = **T**omo **D**ensity **C**ontrol (option) = Amplimat kV - mA controlled

- **Dose measurement sensor type:**

  Bucky amplimat input via **EZX21/22/31/32/41**
  measuring field selection on control desk possible

  Scopo amplimat input via **EZX21/22/31/32/41**
  only center field displayed at the control desk

  !! '*Scopo amplimat'* **must** be programmed in case of a **Junior Diagnost** or **Extremeties**
  !! measuring chamber to prevent from sidefield selection and display.

  Photo sensor input via **EZX61**, if *'none'* has been programmed *at 'Dose measurement input'*, the exposure on signal X_ACT/ to the central part has to be connected via signal bus EZX23

  Photo sensor/ampl. inp. photo sensor input **only** via **EZX41** to get the **REL** signal for AEC **and** all free techniques (as EXON signal)

- **Exposure series / Tomo movement:**

  no = instant brake after exposure end

  yes = - more than one exposure possible with one PREP
  - no underexposure display in exposure series / tomo if *'no'* is programmed at *'RGDVx Data Set B' 'Underexposure display (non automatic techniques)'*

  - has to be *'yes'* for
    - any tomo in combination with a *'Release decade adaptation unit'* 1WA/2WA
    - in case of BuckyTH with TOMO via Bucky Controller (reason: preparation must be active until the tomo stand is back to the start position = „dead-man's" principle)
    - DSI or multiple exposures in SCOPO

(makes **no** sense if *'single step' 'Exposure switch type'* selected)

- **Release delay (automatic techniques):**

  enable **Must** be set for AEC / AECF / TDC / PHOTO TIMER techniques to switch on kV not before the dose integrator has been reset and the offset of the chamber signal line has been measured by Dose Rate Control.
  Must also be enabled for mobile Amplimat stands without grid sync connected.
  - Automatically *'disable'*d if any non-AEC technique is selected.

  disable instant kV with EXPOSURE command, should never be programmed

- **Mounted radiographical controller:**

  none **!! none !!must** be programmed if any *'Release circuit adaptation unit'* is programmed

  Bucky controller 1 = BuckyTH (Sensing) RGDV 1...4 BuckyTH and BuckyTH2
  ditto RGDV 5...8, for Bucky unit easyDiagnost

  Bucky controller 2 = not used

  Thorav. / Dig. Bucky =
  - Thoravision: interface EWD200 via system CAN EZX43
  - Digital Bucky

- **Release circuit adaptation unit:** (old world adapter with 4 release decades)

  none = to be programmed in case of free cassette if no cassette present interlock is required

  !! none !!must be selected if any *'Mounted radiographical controller'* is programmed

  1WA = Bucky / Tomo
  2WA = Bucky / Tomo
  1WB = Scopo / Fluoro / DSI / Bucky
  2WB = ditto, but not yet available

  If an **exposure end beeper** is required in the examination room (even for free cassette) the RGDV must be assigned to the *'Release circuit adaptation unit'* to activate the EXON optocoupler at WA X13/14. This is not required for R/F tables, as they provide the beeper.

- **Mounted tomo extension:** only, if at least one *'Release circuit adaptation unit'* **1WA** and/or **2WA** option is present

  none = ok

  !! none !!must be selected if *any 'Mounted radiographical controller'* is programmed

  1WA \\\ see *'RGDV1...4 Data Set B'*
  2WA /// *'Used for tomo'*

- **Medium II format kV corr. (dose equiv. steps):** range = 0...8 dose equivalent + kV correction steps (see *'kV steps'* page 12)

- **Medium II format density corr. (-6% steps):** range = 0 ... 8 steps of −6% density **[1]**

- **Medium II format mAs corr. (-6% steps):** range = 0 ... 8 steps of −6% mAs **[1]**

- **Small II format kV corr. (dose equiv. steps):** range = 0...8 dose equivalent + kV correction steps (*'kV steps'* see page 12)

- **Small II format density corr. (-6% steps):** range = 0 ... 8 −6% density steps **[1]**

- **Small II format mAs corr. (-6% steps):** range = 0 ... 8 −6% mAs steps **[1]**

!! No automatic addition of medium and small correction values.

[1] see **page 24**

- **RGDV 1**...8 **Data Set B** RGDV_B1

  - **Used for tomo:**

    no = ok

    yes = - has additionally to be set if any *'Mounted tomo extension'* is programmed at *'RGDV Data Set A'* (tomo time input active only in combination with option Automatic input of tomo times 9890 000 02221)
    - has to be programmed in connection with a Bucky Controller System with TOMO, which gives access to the 16 tomo times in the System (tomo time input only in combination with option Automatic input of tomo times 9890 000 02221, see generator STAMMKARTE or *'Options'* screen menu *'Faultfind'*)
    - if *'yes'* is set exposure time +/- corrections are not possible at the control desk

  - **Used for fluoroscopy:**

    no = no fluoro possible

    yes = - only possible in combination with *'Release decade adaptation unit'* **WB** and if programmed in generator function key EZ139 D38, generator base must be R/F
    - if fluoro is set to *'yes'* the menu/APR field at the control desk line 1 column 2 is reserved to display fluoro parameters (kV, mA, time) and can not be used for menu or APR names anymore

  - **CT add on:** for therapy simulator purpose, allows run times >= 16 seconds in continuous fluoroscopy mode

  - **Disable time override:**

    no = default, see *'yes'*

    yes = disables exposure time +/- corrections at the desk
    if a RDGV is *'Used for tomo'* = yes the time +/- corrections are automatically disabled

  - **Tube power factor [%]:** range = 1...100% of max filament kW, affects all filaments of the tube assigned to the RGDV

  - **kV steps:**

    Doseequivalent one 6% kV step equals one 25% density steps

    values: 40, 41, 42, 44, 46, 48, 50, 52, 55, 57, 60, 63, 66, 70, 73, 77, 81, 85, 90, 102, 109, 117, 125, 133, 141, 150 kV

    Min and max kV values will appear as programmed in the *'Tube Limits'* table.

Single = 1 kV steps in-between the programmed limits kV_min and kV_max

- **mAs steps:** 25 % (default), 12 %, 6 % — if film screen combinations with a sensitivity of 400 or higher are in use a 12% stepping should be programmed (for all RGDV)

- **mA steps:** 25 % (default), 12 %, 6 % — if film screen combinations with a sensitivity of 400 or higher are in use a 12% stepping should be programmed (for all RGDV)

- **time steps:** 25 % (default), 12 %, 6 % — if film screen combinations with a sensitivity of 400 or higher are in use a 12% stepping should be programmed (for all RGDV)

- **Density steps:** 25 %, 12 % (default), 6 % — all RGDV should get the same density step factor (and should also be equal to generators next door, (SCP and MedioCP steps are always at 12%)

!! The density correction displayed at the desk only shows e.g. **-1** or **+2**. This **-1** or **+2** can
!! stand for (a) step(s) of 6%, 12% or 25%.
!! All RGDV's (and all systems in the same hospital) should have the same correction factor to
!! get the same result when used. More explanation in *'Change APR Data Set'*.

- **Density correction (6% steps):** range = - 8 ... + 8 steps (see **[1] page 24**)

  - For individual stand or other registration device related corrections

  !! **No** correction should be programmed before the site specific densities in the ***'Dose Rate Control'*** part have been adjusted.

- **Underexposure display (non automatic techniques):**

  yes The underexposure sign is blinking at the control desk to indicate that an exposure has not been terminated by the generator (FU_mA controls all **non-AEC** techniques),
  e.g. if
  - the handswitch has been released too early
  - the sweep time switched by the tomo table is shorter than the programmed exposure time
  - the exposure switch is bouncing.

  no *'no'* **must** be programmed for tomo RGDVs
  (if *'yes'* has been programmed for *'Used for tomo'* at RGDV *'Data Set B'*; times switched from a tomo stand might be shorter than the programmed APRT time)

- **Tube overload protection:**

  on (default), the tube overload protection is on, tube load reductions are active

traffic light status at control desk		
LEDs	load factor [%]	tube temperature
green	100	cold
green + yellow	100	warm
yellow	80	medium hot
yellow + red	64	hot
red	0	**no ready for exposures** only 3mA fluoro

  off As long as PREP has been started from yellow-red status EXPOSURE is possible with 100% load, even with red light on. PREP is not possible in red, ready disappears.

  Must not be programmed for Radiographic or R/F sites.

- **RGDV Interface Assignments**

!!! Nothing should be programmed in this part if the generator is connected to
!!! a *'Bucky Controller 1'* or *'Thorav. / Dig. Bucky'* System via System CAN EZX43.

- **Bucky/Tomo 1WA** and/or **2WA** EWA_X11

- **Decade Bucky 1 (X11)** e.g. WAX11 and/or **Decade Bucky 2 (X12)** WAX12

  - **Tomo mode switch:**

    disable = (default) no remote switchover

    enable = enables Bucky/Tomo remote switchover WAX11 or WAX12 pin 3-4

    If *'enable'* is programmed both Bucky-RGDV **and** Tomo-RGDV have to be programmed (switch related), if only one RGDV is set the generator hangs up

  If a stand with only one remote switchover contact and only one set of tomo trajectory / time decades is present (e.g. D96), the remote switchover contact WAX11:3 and WAX12:3 has to be linked.
  Then RGDV1/2 for Bucky / Tomo and RGDV3/4 DSI / DSI Tomo can be switched over using the same tomo trajectories and times.

  - **Bucky RGDV - switch related: [2]**

    none = default

    RGDV 1...**8**

    - activates the recognition of the Bucky Ready contact WAX11 or WAX12 pin 9-10 (ready = closed)
    - defines the Bucky RDGV for Bucky/Tomo remote switchover, if *'Tomo mode switch'* is enabled (pin 3-4: tomo (DSI tomo) = closed, Bucky (DSI) = open)
    - activates the format size correction contact (closed if > 24x24 cm) WAX11 or WAX12 pin 1-2
      !! if no automatic collimator exists insert a link at pin 1-2 to get access to the side field selection
    - if no Bucky Ready contact exists, but the format size correction has to be active: insert a link at pin 9-10

- **Bucky RGDV [2]**
- **Bucky RGDV [2]**

[2] **three** RGDV's can be programmed at the same Bucky Ready contact

none = default

RGDV 1...**8**

- activates the recognition of the Bucky Ready contact WAX11 or WAX12 pin 9-10 (ready = closed)
- activates the format size correction contact (closed if > 24x24 cm) WAX11 or WAX12 pin 1-2
  !! if no automatic collimator exists, insert a link at pin 1-2 to get access to the side field selection
- if no Bucky Ready contact exists, but the format size correction has to be active: insert a link at pin 9-10

- **Tomo RGDV - switch related**

none = default

RGDV 1...**8**

- **must** be set to activate option **Automatic input of Tomo times**,
  !! if no Tomo Ready contact exists, but the format size correction has to be active: insert a link at pin 5-6, pin 3-4 must also be closed at the same decade
- activates recognition of the Tomo Ready contact WAX11 or WAX12 pin 5-6 (ready = closed)
  !! if no Tomo Ready contact exists, but the format size correction has to be active: insert a link at WAX11 or WAX12 pin 5-6
- defines the Tomo RGDV for Bucky/Tomo remote switchover, if *'Tomo mode switch'* is enabled (WAX11 or WAX12 pin 3-4: tomo (DSI tomo) = closed, Bucky (DSI) = open), if no Bucky/Tomo remote switchover exists, insert a link at WAX11 or WAX12 pin 3-4
- activates the format size correction contact (closed if > 24x24 cm) WAX11 or WAX12 pin 1-2
  !! if no automatic collimator exists, insert a link at WAX11 or WAX12 pin 1-2 to get access to the side field selection

- **Tomo Time** TOMOTIME

Tomo numbers 1...8 can be programmed in the *'APR Data Set'*s. Programming the times makes only sense if option **Automatic input of tomo times** exists (programmed in the CU-function key D38, see STAMMKARTE).
Tomo numbers 1...8 are directly linked to the tomo trajectories WAX22 pins 1...8, while tomo times 1...8 are linked to the tomo time input WAX21 pins 1...8.
Every tomo time has to be programmed with a time in-between 0.1 ... 6000 ms.

*** If tomo APRT's are programmed using option **Automatic input of tomo times**: Select every APRT once. For a very short time the default time of an APRT can be seen at the desk, then the tomo time contact might override the default time. This time must be saved using the desk save function **RESET button + active APRT**. Now the tomo time is fixed. If it is not saved then the default APR time will come up again if the APRT is pushed a second time or if an APR with the same tomo time is selected.
The tomo time input only reacts to a dynamic high >> low time contact change.

- If tomo is programmed at *'RGDV Data Set A + B'* it is not possible to change the exposure time at the desk. If APR with the same tomo trajectory have to be corrected time dependent then an APR with another tomo trajectory has to be selected. Afterwards select the APR which has to be modified to get the high >> low time input response.
- It might happen that three tomo times can be seen at the desk after pushing an APRT button: The first time being displayed is the time saved in the APR. The second time might be tomo time number 1, if all time contacts of the tomo stand are open. If then the tomo timecontact is closed, the status change will effect the display of the programmed tomo time.

- **Bucky/Scopo 1WB** 1WBREADY

  - **Bucky RGDV:**

    Eight RGDV's can be programmed at the same ready contact WBX11pin 9-10
    (R/F controller, ready = closed).
    Activates also the format size correction contact (closed if > 24x24 cm) WB X11 pin 1-2
    (Bucky chambers only).

    !! if no automatic collimator exists, insert a link at pin 1-2 to get access to the side field selection (Bucky chambers only)
    - if no Bucky Ready contact exists, but the format size correction has to be active: insert a link at WBX11 pin 9-10 (Bucky chambers only)

- **Dose Rate Control**

  - **AMPLIMAT**

    - **Sensitivity:** AEC_SENS

      high Sensitivity of basic interface chamber signal amplifier is 4 times higher.
      Only possible with PCB EZ150 version 4512 108 05964 and higher, in this case jumper W4 must be in position 1 (X4). (Some PCB layouts have a X10 print)
      - *'high'* should be set in case of **TDC** (**T**omo **D**ensity **C**ontrol) option (only with PCB EZ150 >= 4512 108 05964 with jumper W4 in position 1 (X4)).
        Exception: If at least one of the Film Screen Combinations has a speed of <200, *'low'* must be selected.
      - *'high'* should be the recommended range if all film screen combinations of the system are >= 200 (only >= 4512 108 05964 with jumper W4 in position 1 (X4)).

      low (default)

      !! Must be low in case of PCB EZ150 versions up to and including 4512 108 05963 and versions >= 4512 108 05964 if jumper W4 is in position 3 (X1)
      'low' must be the recommended range if at least one film screen combination of the system is < 200 (only >= 4512 108 05964 with jumper W4 in position 3 (×1)).

      For *'Photo sensor/ampl. inp.'* at *'RGDV Data Set A'* it does not matter if high or low is programmed.

    - **Chamber 1** ... 5

      - **Data Set 1** ... 5 CH1_D1

        - **DRC Handling / Start Automatic DRC Processing**

          - **<OK>** Every empty line of this window has to be filled:

            >> For PCR/FCR/KCR/ADC (computed radiograpy or dry cassettes see
            >> details **(1) to (6).**

FILM	default data file	:	**FILM.TDL**	**(1)**
SCREEN	ditto	:	**SCREEN.TDL**	**(2)**
CHAMBER	ditto	:	**CHAMBER.TDL**	**(3)**
CASSETTE	ditto	:	**CASSETTE.TDL**	**(4)**
SYSTEM CORRECTION	ditto	:	**SYSCOR.TDL**	**(5)**
CORRECTION FACTOR			range = 0.00 ... 9.99	**(6)**

(1) If the film type is not in the default data list, then select one of the film files: **FILM_BL.TDL** (blue), **FILM_GR.TDL (**green), **FILM_UV.TDL** (ultra violet). Select the one which matches the sensitivy factor S and RLF compensation. **S** is a multiplication factor for the speed type of the screen:
if the screen = 400 and S_film = 0.5, then the total system is 200.

PCR: Select from **FILM.TDL:** **X-CONSTANT RLF=1**

(2) If the screen type is not in the default data list file **LUMAT.TDL** can be selected: It contains the luminous groups LG with different colors and different speeds.

PCR: Select from **SCREEN.TDL:** **X-CONSTANT DV=1VOLT**

(3) The following list gives the PEI-No. of the chambers which can be selected from the data file **CHAMBER.TDL** and the typical dose request values.

PCR: Select from **CHAMBER.TDL:** the installed chamber type

	name in data set	[µGy/V]	supply EZ150 W2/W3 15V / 40V
typical Hybrid	9803 509 . typ.Hybrid	5.85	only 40V
typical ALC	9890 000 ..1 typ.ALC Pb	5.24	15V or 40V
typical ALC	9890 000 ..2 typ.ALC Ag	5.24	15V or 40V
Bucky	9803 509 10002	5.85	only 40V
Bucky	9890 000 01611	5.24	15V or 40V
Bucky	9890 000 01612	5.24	15V or 40V
Childrens Bucky	9803 509 10102 Ch.Bucky	5.41	only 40V
Childrens Bucky	9890 000 01621 Ch.Bucky	4.81	15V or 40V
Childrens Bucky	9890 000 01622 Ch.Bucky	4.81	15V or 40V
Chest	9803 509 50002 Chest	5.85	only 40V
Chest	9890 000 01661 Chest	5.24	15V or 40V
Chest	9890 000 01662 Chest	5.24	15V or 40V
Scopomat 42/52	9803 509 30202 Scopo42/52	5.68	only 40V
Scopomat 42/52	9890 000 01651 Scopo42/52	5.08	15V or 40V
Scopomat 42/52	9890 000 01652 Scopo42/52	5.08	15V or 40V
Scopomat 63/73	9803 509 30002 Scopo63/73	5.32	only 40V
Scopomat 63/73	9890 000 01631 Scopo63/73	4.81	15V or 40V
Scopomat 63/73	9890 000 01632 Scopo63/73	4.81	15V or 40V
Scopomat 71/74	9803 509 30102 Scopo71/74	5.15	only 40V
Scopomat 71/74	9890 000 01641 Scopo71/74	4.63	15V or 40V
Scopomat 71/74	9890 000 01642 Scopo71/74	4.63	15V or 40V
Neuro Diagnost	9803 509 50102 Neuro D .	8.06	only 40V
Neuro Diagnost	9890 000 01671 Neuro D.	7.14	15V or 40V
Neuro Diagnost	9890 000 01672 Neuro D .	7.14	15V or 40V
Cranio Diagnost	9803 509 50602 Cranio D.	8.06	only 40V
Cranio Diagnost	9890 000 01681 Cranio D.	7.14	15V or 40V
Cranio Diagnost	9890 000 01682 Cranio D.	7.14	15V or 40V
Puck 35x35	9803 509 60002 Puck 35x35	4.37	only 40V
Puck 35x35	9890 000 01691 Puck 35x35	3.94	15V or 40V
Puck 35x35	9890 000 01692 Puck 35x35	3.94	15V or 40V
	name in data set	[µGy/V]	supply EZ150 W2/W3 15V / 40V
Extremities	4512 102 80261 Extremity	10.10	only 40V
Extremities	4512 104 47621 Extremity (9803 509 51202)	1.14	15V or 40V
Junior Diagnost	4512 103 06661 Junior D. (9890 509 51202)	3.32	only 40V
Junior Diagnost	4512 104 47621 Junior D. (9803 509 51202)	1.14	15V or 40V

Mammo Diagnost	4512 127 98802 MammD.	3.32	only 40V
Mammo Diagnost	4512 127 98803 MammD.	1.40	15V or 40V
Mammo UCBC	4512 104 18811 MamUCBC	3.32	only 40V
Mammo	4512 104 47621 Mammo (9803 509 51202) X-CONSTANT DV=1VOLT	1.40 5.00	15V or 40V

(4)

normal cassette (default) Al		double sided screen	(factor 1.00)
carbon fiber cassette		double sided screen	(factor 1.12)
1/2 screen	normal cassetteAl	singe side screen	(factor 0.50)
1/2 screen	carbon fibre cassette	singe side screen	(factor 0.56)

factors can not be changed

PCR: Select from **CASSETTE.TDL:** **nornal cessette(def)**

(5) no correction (ISO9236-1) = linear kV behaviour

low-kV-correction = correction factors kV dependent:

kV	40	50	60	70	80	90	100	120	140	150
factor	0.7	0.78	0.89	1.0	0.99	0.95	0.92	0.94	0.98	1.0

PCR: Select from **SYSCOR.TDL:** **no corr.(ISO9236-1)**

(6) The default value is 1 representing a density of 1. If no PC-hardkey exists, this field is the only chance to modify the density of the programmed FSC.

PCR: 1

Without a PC hardkey: If the value has to be changed to the desired density after a test exposure + density measurement, the entire set has to be programmed again with a new correction factor.
If the PC-hardkey exists, use the function *'Start Automatic DRC Processing'* >> *'<CANCEL>'* and keep the correction value on 1, if not use the following formula:

$$\frac{\text{desired density}}{\text{measured density}} = \text{new [}\textit{'CORRECTION FACTOR'}\text{]}$$

The name of the FSC is the abbreviation of the resulting speed and the color of the film screen combination. There might be names like **B400** for a blue 400 speed combination or **G200** for a green 200 combination.
The name can be changed (only with the PC-hardkey), see *'Start Automatic DRC Processing'* = *'<CANCEL>'* or *'<ESC>'*.
The name **must** be changed if different film screen systems with the same resulting name exist. A change from one G200 to a second one can not be recognized at the desk.
Combinations of systems with different colors can not be programmed the automatic way (even though they exist), it requires a special procedure.

If film screen combinations are used at different chambers a data set, once programmed, can easily be copied to other chambers/data sets (only with the PC-hardkey):
Use the *'<CANCEL>'* function, the data screen will be displayed. With the **Save** function **<F3>** the data screen can be loaded to the disk/harddisk with any file name (e.g. Ch1D1). If a data set is opened at another chamber the saved file can be **Load**ed with **<F4>** + file name to the open data set. **Transmit** the data set with **<F2>** thereafter.

- **<CANCEL>** or: use <ESC> >hardkey<

Only two values of the *'Data Set'*s of the *'Chamber'*s can/should be changed (*'Abbreviation'* and *'Dose of FSC'*), all others **must not** be changed (e.g. kV dependent characteristics).

If digital cassettes (PCR/FCR/KCR) are used or DigitalBucky, type the desired sensitivity (speed type) in the name field, e.g. PCR200. Thoravision provides special DOSE names.
The value *'Dose of FSC [µGy]:'* = K_s must be calculated:

$$\frac{1000\mu Gy}{\text{speed system}} = K_s \qquad \text{example: } \frac{1000\mu Gy}{200} = 5\mu Gy$$

Abbreviation:

The name of the film screen combination can be changed into every 6 digit string.
An FSC can be erased by filling the name field with blanks,
but: !!
There should **never** be a gap in-between the FSC data sets of a chamber. If only one FSC is used, it **must** be at data set 1, the second **must** be on 2 etc. If e.g 4 data sets are active and the 1st will be erased by blanks (spaces), all FSC's are no more accessable and AEC is no more available for this RGDV.
If any FSC will be removed from the last position all APR linked to this FSC have to be programmed to any other still existing FSC, otherwise no FSC will be displayed at the desk. When these APR are changed to another FSC the background mAa values have to be adapted to the FSC sensitivity.

Since Release 3 predefined APR data sets can be programmed with the FSC name = *'Abbreviation'*. If the abbreviation string and the name in the APR data set are identical, the FSC will be associated to the APR data set.
If no name is given in the default APR data sets, APR will be assigned according to the **Recommended Dose** in the default APR data sets. How these are set can only be seen with the help of **APRMAN**ager if the APR data screen is open.

Dose Request Chamber [µGy/V]: range: 0.50...32 µGy/V

Dose of FSC [µGy]: range: 0.45...100 µGy

The initial value *'Dose of FSC [µGy]:'* of the *'DRC Handling / Start Automatic DRC Processing'* (calculated by XRGSCOPE in the service PC) in is to achieve a density of **1.0**. It can be changed into any other desired value, e.g. 1.5:

$$\frac{\text{desired density}}{\text{measured density}} * \text{default } [\textit{Dose of FSC}] = \text{new } [\textit{Dose of FSC}]$$

If default APR from the instaltion disk are selected with AEC technique the exposure data at the desk will display the abbreviation of the FSC and a default **zero** with a triangle for the density. This **zero** should be the basic value for the desired density. It will not change even if the value for the *'[Dose of FSC]'* is being modified.

- **Image Intensifier** IMA_INTE

The **II** lead time, density voltage correction (default 1V), and the dynamic factors can be modified if necessary.

- **Fault Exposure Detection**

  - **AEC** Detailed explanation and sketches see doc FAULTFINDING

    off = No 4% dose supervision at 10% of the backup exposure time, automatically off after APR overriding

    on = (default) At 10 % of the backup exposure time (APR mAs value) DRC detects if at least 4% of the expected dose have been measured. If not, the exposure will be switched off by CU.

  - **TDC** Detailed explanation and sketches see doc FAULTFINDING

    off = No 4% dose supervision at 10% of the backup exposure time, automatically off after APR overriding

    on = (default) At 10 % of the backup exposure time (APR mAs value, tomo time > 1000ms, not before 250ms) DRC detects if at least 4% of the expected dose have been measured. If not, the exposure will be switched off by CU.

- **CONT** factors for continuous fluoroscopy can be modified: CON_FLUO

  scantime_TV [ms]: default = 20 ms (for 50 and 60 Hz)
  range = 0 ... 60000 ms

  scantime_TV valid: **yes** = default
  must be *'yes'* without CAN driven R/F system controller
  no = only possible with a CAN driven R/F system controller

  P_max_EDL [W]: default = 250W
  range = 0 ... 9000 W, max entrance dose limitation, active, if WB X12 pin 1-10 closed (SID < 100 cm) see doc ADJUSTMENTS

  TV_pos_limit [V]: default = 6.885 V
  range = +3 ... +7.5 V ADC input of TV chain

  TV_neg_limit [V]: default = -6.885 V
  range = -7.5 ... -3 V ADC input of TV chain

- **Fluoroscopy Curves** FLUO_CU1

  20 Fluoroscopy curves can be loaded from predefined fluoro curves. There are 3 curves available from the installation disk file **FLUOCURV.TDL**:

	start values	**kV-mA characteristic**							
	50 kV	40	50	60	70	80	90	100	110 kV
6mA default 1	0.5 mA	0.25	0.5	0.95	1.7	3.0	5.0	5.5	6.0 mA
6mA default 2	0.4 mA	0.25	0.4	0.60	0.8	2.0	4.0	5.0	6.0 mA
3mA	0.5 mA	0.22	0.42	0.7	1.2	2.15	2.7	2.95	3.0 mA

  One of the programmed curves (1...20) has to be attatched to the APR data set, see *'Change APR'*.

  If other curves are required, send your request to Helpdesk Hamburg.

- **Application Limits**

  - **X-Mode Limits** X_MO_LIM

    Limits can be modified within the range of the value fields. Values should not increase the local limits.

    All **AEC** techniques have a default **max mAs** limit of **580 mAs** (to meet the HHS limit of 600mAs).

    Even that **free techniques** show 1000mAs as default limit, the absolute limit which can be selected at the control desk is **850mAs**.

    The *'Max. Time Limit'* of 60000ms is only available if *'CT add on'* has been selected at *'RGDVx Data Set B'* and if option is present.

  - **Thoravision Limits** THO_LIMI

    Table of default max mAs values (kV dependent) to prevent an over-saturation of the Thoravision detector drum (**memory effect**).

  - **Overload dependent Limits** for continuous fluoroscopy OLO_LIMI

    Max. current for conti. fluoro [mA]: range = 3 ... 20 mA

    Max. current during overl. for conti. fluoro [mA]: range = 1 ... 3 mA

    overload conditions, (red traffic light on only):

    - tube housing temperature contact open
    - tube temperature supervision TTS (calculated) detected overload

- **Human Interface**

  - **Select Language** **English** / **German** / **French** / **Spanish** — Messages like **door open**, **menu** etc. and language dependent charactes (table see doc INSTALLATION) are related to the programmed language.

    LANGUAGE

  - **APR Data Set** SEL_APR

    - **Select APR Data Set**

      Select any APR at the desk, the name will be highlighted. After <Return> at the PC the APR # will be displayed on the PC screen. This # can be used for *'Inquire APR Assignments'* or to move APR.
      Once this *'Select APR Data Set'* window is transmitted with <F2>, the following *'Change APR Data Set'* command allows to look into the complete APR data set.
      (It is **not** possible with the default **Test APR**.)
      Any APR # in-between 1 and 1024 can be typed in, no matter to which RGDV this APR # is assigned to.

- **Change APR Data Set** CHA_APR

  This function opens the window to modify the entire APR data set. Data marked with a **[3]** can only be changed in this window via service PC.
  All other non-marked data can also be changed at the desk and saved thereafter via the button combination **RESET** (hold it) + the **highlighted APR**,
  but: see *'APR modifiable by User'.*
  (Change APR is **not** possible with the default **Test APR**.)

  Note: If only a few APR data sets have to be maintained one can use these functions. If more APR data sets shall be modified the use of **APRMAN.EXE** (part of the installation files) is much easier and faster.

- **[3] APR number:** is just a (randomly given) pointer (house number)

  This number can be used to copy a data set into another data set. To do so the destination APR number (*'Select APR Data Set'*) has to be filled in the *'APR number'* field, afterwards transmit with <F2>. The source data set does not change.
  To move an APR data set copy a data set to the desired destination and delete the source APR data set afterwards with *'APR deassign'*.
  There has to be an active destination APR. Error 00BR will come up if a data set is loaded/copied to an APR number which is not assigned to any RGDV.
  If APR backups are reloaded the APR numbers of the backup file will be the same after reloading except
  - if the APR numbers are already occupied
  - if a default data set from the installation disk is used
  - if an individual RGDV backup file will be loaded to another RGDV of the same generator.

  Note: *'APR number'*s should not be changed if the generator is in combination with a BuckyTH or TH2 system via CAN. Otherwise the assignment of APR#s for the control handle will be lost.

- **[3] APR name:** 16 characters are possible

  If special letters are needed (language dependent) see doc INSTALLATION character codes.

  Note: Since Bucky controller release 5.x for BuckyTH2 a "=" character **must** be at the end of the APR name string to get a ready display for grid used RGDV / APR.
  APR for RGDVs 1+2+3 with **Inalpha** trays must always have the "=".
  APR for **ACL4** trays with removable grid must have the "=" when the grid shall be used
  and **no "="** when the **grid** shall **not be used** (removed from the tray to get a system ready) for application reasons.

  If APR data are changed at the desk the two last digits of the 16 character field will be used to indicate '_*' = 'overriding'.
  Example: **[infant 10-15 yrs]** will change into
  [infant 10-15 y _*] after overriding.

- **Focus:**
  small = small filament of the tube
  middle = (in case of a 3 focal spot tube, not yet available)
  large = large filament of the tube
  vario = is a virtual focal spot, its size (tube type dependent) in-between large and small focus can be selected via the *'Vario focus ratio'*, only with **RO17/50, SRO09/51, SRO25/50, SRO33/100** and if option is present

- **[3] Vario focus ratio**: range: 20%, 35%, 50% (default) , 65%, 80% of small focus

  Sets the ratio of small and large focus, for tubes with superimposed focal spots.
  The ratio should be typed in the *'APR name'* field at the end of the line if the 16 digits allow so. Example: 'Thorax_ap____50%'

- **([3]) Dose measurement field (left): on / off**
  Dose measurement field (middle): on / off
  Dose measurement field (right): on / off

  At least one of the measuring fields must be *'on'* to have access to AEC technique even if the *'Preferred technique'* is set to *'No AEC technique'*.
  A chamber must be programmed at *'RGDVx Data Set A' +'Dose measurement input'*.
  The default APR data set [### APR name ###] has all 3 fields *'on'*.
  Some customers like ho have **technique APR's** only. If so switch *'off'* all fields so that there is no way to change to AEC technique if AEC is possible at the same RGDV / menu / page.

- **[3] Preferred technique:**

  Non automatic

  One out of the three *'No AEC technique'*s will be displayed at the major exposure data display.
  With the **mA-s** technique button at the desk one can switch over from kV-mA-ms (LED on) to either kV-mAs or kV-mAs-ms technique (LED off), depending on what has been programmed.
  If a *'Dose measurement input'* and/or *'Dose measurement sensor type'* is programmed at *'RGDVx Data Set A'* and at least one *'dose measurement field'* is *'on'* this APR can be used for AEC technique, which will cause the overriding sign ' *' coming up.

  Automatic

  AEC/TDC technique will appear when this APR is selected (AEC technique button LED and 1...3 measuring field LED's on).

  *** All predefined APR data sets from the disk are programmed for a 400 speed system. If then e.g. a 200 speed system exists, all non-AEC technique values (e.g. mAs) have to be doubled, if an 800 speed system exists, the mAs values must be divided by 2.

- **[3] AEC technique:**

  AEC falling load kV the mA start value of the falling load exposure will appear in the *'Exposure data I [mA]'* field

  AEC fixed current kV-mA the fixed mA value has to programmed in the *'Exposure data I [mA]'* field

  Select **kV-mA-ms (RUIT)** at *'No AEC technique'*

TDC (Tomo Density Control) (option, see STAMMKARTE)

the TDC start mA value or the desired mAs value in combination with the tomo sweep time has to be programmed in the *'Exposure data I [mA]'* field

Select ***'kV-mA-ms (RUIT)'*** or ***'kV-mAs-ms (RUQT)'*** at *'No AEC technique'*

- **[3] No AEC technique:** = all non-Amplimat techniques

Two out of the three *'No AEC technique'*s are available for every APR.
If either **kV-mAs** or **kV-mAs-ms** technique is selected one can switch over to **kV-mA-ms** technique pushing the **mA-s** button at the desk.
If **kV-mA-ms** technique is programmed in the APR and it will be deselected by pushing the **mA-s** button (LED off) it only changes to **kV-mAs** technique.
The preferred *'No AEC technique'* after AEC-deselect can be changed at the control desk with the overriding-save function.

!!! If **kV-mAs-ms** technique is selected as preferred it will change to **kV-mAs** if the APR data set has been modified at the control desk and has been saved with **kV-mA-ms** technique selected **!!!**

kV-mA-ms technique (RUIT) (Radiographic **kV-mA-s**), choice of **kV**, **mA** and **ms** parameters

Must be selected in case of *'AEC fixed current kV-mA'* and can be selected for *'TDC (Tomo Density Control)'* techniques.

kV-mAs technique (RUQ) (Radiographic **kV-mAs**), choice of **kV** and **mAs** parameters

kV-mAs-ms technique (RUQT) (Radiographic **kV-mAs-s**), choice of **kV**, **mAs** and **ms** parameters

Should be selected as the best non-AEC technique for TDC technique APR.

This technique is very helpful for tomography. Exposure time and mAs can be selected individually, depending on the tomo sweep time and the organ & patient size.
Time +/- selection is not possible if RGDV is programmed *'Used for tomo = yes'* at *'RGDVx Data Set B'*. It must be programmed in the APR or the time selection is controlled by automatic input of tomo times (decade WAX21 or Bucky controller).

Depending on one of these 3 techniques only the relevant parameters in the following *'Exposure data nn'* have to be modified. All other parameters will be calculated by the generator itself after transmission with <F2>. If the same APR data set screen will be called again, the changes of the 'slave values' can be seen.

*** All predefined APR data sets from the disk are programmed for a 400 speed system. If then e.g. a 200 speed system exists, all non-AEC technique values (e.g. mAs) have to be doubled, if an 800 speed system exists, the mAs values must be divided by 2.

- **[3] Tube current max. factor [%]:** range = 1...100% (default 100 %)

The max emission current can be modified within the above range.
The reduced current (see *'Exposure data I [mA]'*) can be the start mA value of the AEC exposure. It will be a constant value during the exposure until it comes to a point where the mA have to be reduced (falling load) within 4000ms. The mA value as the result of the % reduction is different at each kV value.

The mA value can be seen if the APR data set screen has been transmit with <F2> once. Call the same *'Change APR'* data set again and the calculated mA value appears.

Another way to see the mA is at the desk: Push the APR button, switch off AEC. The background technique will come up. In case of kV-mAs or kV-mAs-s push the mA-s button to switch over to kV-mA-ms technique. The displayed mA is the value which is one step below the max value in the row of the programmed mA steps (*see 'RGDVx Data Set B'*). Now push the +mA button to get the max mA value. This is the same as in the data set on PC.
If an APR with small focus will be changed by pushing the large focus button the +mA has to be pushed until the max value appears. A change from large to small will immediately display the max mA.
The calculated mA value should be typed in the APR label, so that the customer gets a chance of minimum selection criteria. One should tell him that the mA value changes with the +/- kV and focus selection.

!! The modification of the max factor will lead error 00L$ if the resulting mAs value is below 0.5 mAs.

!! Take care that there are not too many additional reductions programmed **!!**

- **[3] PSC U thin (dose equivalent steps):** range = 0...-5 dose equiv. kV steps

  small **P**atients **S**ize **C**orrection kV

- **[3] PSC U thick (dose equivalent steps):** range = 0...+5 dose equiv. kV steps

  large **P**atients **S**ize **C**orrection kV

- **[3] PSC Q thin (6% steps):** range = 0...-10 mAs steps see **[1] page 24**

  small **P**atients **S**ize **C**orrection mAs

- **[3] PSC Q thick (6% steps):** range = 0...+10 mAs steps see **[1] page 24**

  large **P**atients **S**ize **C**orrection mAs

- **[3] PSC density thin (6% steps):** range = 0...-10 dens. steps see **[1] page 24**

  small **P**atients **S**ize **C**orrection density correction

- **[3] PSC density thick (6% steps):** range = 0...+10 dens. steps see **[1] page 24**

  large **P**atients **S**ize **C**orrection density correction

[1] Depending on the step rate of **mAs-** and **density-correction** programmed at *'RGDVx Data Set B'* these correction values must have an even factor with the basic step rate:
To get a correction of one mAs-correction step 25 % (Data Set B) four 6%-steps have to be programmed here.
To get a +1 density step displayed two 6%-steps have to be programmed if 12%-steps are programmed at *'RGDVx Data Set B'*.

- **Exposure data U [kV]:** range = 40...150 kV or what has been programmed at *'Tube limits'*

  If full kV range is not available, check *'Tube limit'* settings.

- **Exposure data I [mA]:** range = 0.1...2000 mA

  Depending on the generator version, tube type, focal spot, selected technique and all reduction factors; this value can be a master or slave value.
  The result of a [mA]*[ms] mulitiplication must always be >= 0.5 mAs.

  If full mA range is not available, check *'Tube limit'* settings or all other reduction tables.

- **Exposure data Q [mAs]:** range = 0.5...1000 mAs

  Depending on the tube type, focal spot, selected technique and all reduction factors; this value can be a master or slave value.

  If full mAs range is not available, check *'Tube limit'* settings or all other reduction tables.

- **Exposure data t [ms]:** range = 1...16000 ms

  Depending on the tube type, focal spot, selected technique and all reduction factors; this value can be a master or slave value.
  The result of a [mA]*[ms] multilplication must always be >= 0.5 mAs.

  If full range is not available, check *'Tube limit'* settings or all other reduction tables.

- **Exposure data density (6% steps):** range = -16...+16 density steps at 6%

  Depending on which step rate has been programmed at *'RGDV Data Set B'*, explanation see *'PSC density thick'* see **[1] page 24**.

*** If APR with AEC are linked to a certain Film-Screen-Combination the basic density value of this FSC appears as a **zero**, because this **zero** (X) - value is based on a density of 1. Even if the density has been modified to e.g. 1.5 the **zero** (X) remains at the major exposure data display at the desk.
There are organs where the **zero** density is the right one, but also some where a X-2 or a X+3 correction must be programmed. SCP and MedioCP are based on 12% steps for every +/-1 correction, so should the Optimus be programmed at *'RGDVx Data Set B'*. For every +/- 1 step based on 12% +/- two 6% steps have to be set here.

- **Film screen comb.:** Gives the selection of all available FSC names programmed at the chamber being connected to the RGDV where this APR is assigned to. Default = def 1, if no FSC programmed yet.

Since Release 3 predefined APR data sets can be programmed with the FSC name = *'Abbreviation'*. If the *'Abbreviation'* string and the name in the APR data set is identical, the FSC will be associated to the APR data set.
If no name is given in the default APR data sets, APR will be assigned according to the **Recommended Dose µGy** in the default APR data sets which ***'Dose of FSC [µGy/V]'*** is the closest.
How these are set can only be seen with the help of **APRMAN**ager.
The **Recommended Dose µGy** value can not be seen in this screen via XRGSCOPE.

*** All predefined APR data sets from the disk are programmed for a 400 speed system. If then a 200 speed system exists, all non-AEC technique values (e.g. mAs) have to be doubled, if a 800 speed system exists, the mAs values must be divided by 2.

- **[3] Tomo Number:**
  1 = default
  1...8 = via *'Release circuit adaptation unit'* 1WA or 2WA
  1...16 = *'Bucky Controller 1'* via CAN

  Only relevant if option **Automatic Input of Tomo Times** 9890 000 0222x is programmed in function key D38 on CU (see STAMMKARTE on kV_power cover plate or *'Options'* at *'Faultfind'*).

  Activation at *'RGDVx Data Set A + B'*, *'RGDV Interface Assignments'* and *'Tomo Time'* for the programmed *'Release circuit adaptation unit'*. Then 8 tomo numbers are available.

In case of *'Bucky Controller 1'* systems with TOMO 16 tomo times are available:

tomo # BuckyTH	tomo # Optimus	sweep	tomo # BuckyTH	tomo # Optimus	sweep
0	1	8°/0.8s	8	9	30°/1s
1	2	8°/1s	9	10	30°/2s
2	3	8°/2s	10	11	30°/3s
3	4	20°/0.8s	11	12	30°/4s
4	5	20°/1s	12	13	40°/1.2s
5	6	20°/2s	13	14	40°/2s
6	7	20°/3s	14	15	40°3s
7	8	30°/0.8s	15	16	40°/4s

If no tomo unit is present: **ignore**.

Tomo via decades (1WA or 2WA):
If tomo APRT's are programmed using option automatic input of tomo times: Select every APRT once. For a very short time the default time of an APRT can be seen at the desk, then the tomo time contact overrides the default time. This time must be saved using the desk save function RESET button + highlighted APRT. After that the tomo time is also fixed in the APRT. If it is not saved the default APR time will come up again if the APRT is pushed a second time. The same happens if an APR with the same tomo number is selected. The tomo time input only reacts to a dynamic high-low status change of the incoming time contact 1/2WA X21:1...8. The times can only be changed in the data set via PC or if another time will be selected to switch back to the same tomo time.
It might happen that tomo time 1 comes up at the desk for a very short time. This is dependent on the delay times in-between the switch off of the old tomo time contact and the switch on moment of the selected tomo time contact.

Tomo via Bucky-controller:
If the default programmed tomo times in the APR data set are different to the tomo times sent by the bucky system the default APR time appears for a very short moment, then the time will be overridden by the contoller message. If so, use the save function of the desk to fix the proper tomo time in the APR data set.

- **[3]** **Spectral Filter:**

  gives a selection of the three filter types of the GALILEO collimator via bucky controller
  no filter
  2 mm AL
  0.1 mm CU + 1 mm Al
  0.2 mm CU + 1 mm Al
- **[3]** **Fluoroscopy curve:**

  One out of the 20 *'Fluoroscopy curves'* (if all are programmed) can be selected.

- **Inquire APR Assignments** INQ_APR

  The OPTIMUS has 1024 APR. Once activated, every APR data set gets an APR #. These #s are given without any special system (it is more ore less random). If a certain APR # is known, typed in and transmit with <F2>, the window coming up gives the APR name, the RGDV and menu where it is assigned to (blank in case of none), the page, line and column of its position.
  If an APR # is typed in which is not assigned to any RGDV the location fields (RGDV, menu, submenu, page etc.) are empty, the name might be [### APR name ###] or any old name of an APR which has already been deassigned.
  To get the APR #, just select any APR button at the desk. Then use *'Select APR Data Set'*. (It is not possible with the default **Test APR**.)

- **RGDV related Assignments**

  - **RGDV 1** ... 8

    - **Predefined Assignments**

      The **Load Data from Disk** window offers all predefined APR data sets of the installation disk or other predefined files (or use APRMAN.EXE to create customized data files, the last version is always on BBS).

      The name of these files is A*******.TDL, details:

AR_EMPTY	for generators without APR option 9890 000 0282x
CO	Cosmos
TR	Trauma
TS	BuckyTS
DS	DSI, easyDiagnost
D15 / D76	R/F systems
V	Vario focus RO17/50, SRO25/50, SRO33/100
V9	Vario focus SRO09/50
ATS..V	BuckyTS with Vario focus RO17/50, SRO25/50, SRO33/100
AT..V9	BuckyTS with Vario focus SRO09/50
DE(U)	German
EN(G)	English
ES(P)	Spanish
FR(A)	French

      The files may contain e.g. data sets in a window **Available Examination Unit Type**:

BUCKY GR	Bucky table APR under a **group** (menu) layer
BUCKY PA	Bucky table APR **paging** (scroll through the APR pages)
WALLSTD GR	Bucky wallstand group
WALLSTD PA	Bucky wallstand paging
FREE GR	Free technique (non-AEC) group
FREE PA	Free technique (non-AEC) paging
TOMO LT/HDH	Tomograpy group
TOMO LIN/PA	Tomography paging

      System names are also mentioned in the offered data sets.

      After the end of the transmission from the PC to the generator **waiting** will appear on the PC screen. Now the generator is calculating the source data from PC to the individual installation parameters (generator power, tube type etc.). The generator **must not** be reset before **waiting** disappears, otherwise APR which have not yet been calculated at that moment are lost.

      Individual RGDV related backup files (APR_BAKx.TDL, x = 1...8) can also be loaded to the generator with the same *'Predefined Assignment'* function.

      It is possible to load all RGDV with predefined APR data sets and make one generator reset at the end of all loading procedures. After every reset all newly loaded APR and menus appear at the desk.
      It is not possible to load a second data set on top of an existing data set. The old RGDV menu/APR structure has to be erased before with *'Delete Menu'*.

      With the XRGSCOPE - *'File'* option one can use the editor to modify the predefined APR data sets or backup data sets (e.g. to change all APR to large filament in case of a single filament tube).
      This is easier and faster as if every APR will be selected at the desk as if *'Select APR'* followed by the *'Change APR'* function is used. One advantage is that this can be done at the PC offline the generator.
      The handling is very easy, is is almost similar to the *'Change APR'* screen online with the

generator. After modification the data set has to be saved with <F3>, the filename could be the same or any other.
Only data sets with up to 50 APR can be modified. There is no way co change the amount of APR.

Note: **It is much easier with the APRmanager APRMAN.EXE.** (Some of the manual modes explained here are running in the background of APRMAN).

- **Manual Assignment**

  - **APR Assignment**

    - **Select Menu** SEL_MENU

      The menu name field is as long as the longest menu name. If the field is only two digits long and only one field is displayed after <RETURN> there is no menu.
      If no menu structure exists, proceed directly to *'Assign APR'*.
      If APR's shall be in a menu structure, assign this(these) before in *'Menu Assignment'*.

      If an APR shall be added to a menu this has to be selected first. Transmit this window with <F2> after selection.

    - **Assign APR**ASS_APR

      An APR position has to be opened first, after a cold/warm reset the new position can be selected at the control desk to be modified thereafter (see *'APR Data Set'*).

      APR:
      The window will offer either **### APR name ###**, which is the default data set or, if there have already been other APR structure, some other names of deassigned APR's (see *'APR Deassign'*).

      Page No.:
      Line No.:
      Column No.:
      It indicates (automatically) the position where it will be loaded to:
      page, line and column.

      The order of APR assignment on a page is always like this:
      column **1** line **1** **2** **3** **4**
      and then
      column **2** line **1**(*) **2** **3** (**)

(*) - if a RGDV is used for fluoro, column 2 line 1 position is used to display the fluoro parameters (kV, mA. fluoro time) and can not be used for assignments

(**) - if APR's are programmed at a menu, the next APR will be assigned to the next page column 1 line 1,
position column 2 line 4 indicates 'menu' to come back to the menu screen
- if no menu structure exists column 2 line 4 will be the next APR position, followed by the next page column 1 line 1 etc.

Any position can be typed in. If the position is already occupied, an error will come up.
If only one APR at position column 2 line 3 exists at a menu structure, the next APR position will be on the next page, even if all other postitions on this page are free. The automatically given position can be changed to fill up empty positions.
Do not assign an APR at position column 2 line 4 at a menu structure, it will be transmitted to nowhere.

- **APR Deassign**

  - **Select Menu**

    The menu name field is as long as the longest menu name. If the field is only two digits long and only one field is displayed after <RETURN> there is no menu.
    If an APR shall be removed from a menu structure this menu has to be selected first.
    If no menu structure exists, proceed directly to *'Deassign APR'*.

  - **Deassign APR** DEASS_AP

    'Deassign APR' gives a selection of the APR programmed at a menu or a paging structure (it does not matter if there are empty fields in-between the APR).
    Deassigned APR are not totally lost. There might be access to deassigned APR at *'Assign APR'* if the amount of APR is <= 500.
    Deassigned APR can still be seen at the desk if no generator warm reset was made after deassignment, but they can not be used anymore.

- **Menu Assignment**

  - **Select Menu** SELNEMEN

    There are structures possible with a menu layer first and a second (up to 10) submenu layer.
    Creating submenu structures: first assign the main menus at *'Assign Menu'*. Then *'Select Menu'* and program the submenu names at the main menu with *'Assign Menu'*.

    !!! At least one APR has to be programmed to one of the lowest menu or submenu layer to have the structure fixed.
    If once an APR is programmed to a menu there is no further submenu layer possible.
    The *'Select Menu'* name field is as long as the longest available menu name. If no menu is available there will be the message **The requested table is empty**.

  - **Assign Menu** ASS_MENU

    This function can be used to assign menus to an empty RGDV. It can also be used to add a menu to an existing menu structure (in the same layer) or to create / add submenus.
    Menus can not be assigned if a paging structure with APR only is programmed or within an APR layer.
    Submenus can not be assigned if APR's already exist at a menu. In this case no menus are offered at *'Select Menu'*.

    Menu Name:

Note: Since Bucky controller release 5.x for BuckyTH2 a "=" character must be at the end of the APR name string to get a ready display for grid used RGDV / APR. Menus with such APR should also have this "=" character to indicate the use of the grid.
APR for RGDV 1+2+3 with **Inalpha** trays must always have the "=".
APR for **ACL4** trays with removable grid must have the "=" when the grid shall be used and **no "="** when the **grid** shall **not be used** (removed from the tray to get ready) for application reasons.

Page No.:
Line No.:
Column No.:
It indicates (automatically) the position where it will be loaded to:
page, line and column

The order of menu assignment on a page is always like this:

column **1**	line	**1**	**2**	**3**	**4**
and then					
column **2**	line	**1**(*)	**2**	**3**	(**)

(*) - if a RGDV is used for fluoro, column 2 line 1 position is used to display the fluoro parameters (kV, mA. fluoro time) and can not be used for assignments

(**) - if menus are programmed at a menu, the next menu will be assigned to the next page column 1 line 1, position column 2 line 4 indicates 'menu' to come back to the higher menu level
- if no menu structure exists column 2 line 4 will be the next menu position, followed by the next page column 1 line 1 etc.

The automatic positioning unfortunately also takes the position which is occupied by the fluoro kV/mA and time label.

Any position can be typed in. If the position is already occupied, an error will come up. If only one APR at position column 2 line 3 exists at a menu structure, the next menu position will be on the next page, even if all other postitions on this page are free. The automatically given position can be changed to fill up empty positions.
Do not assign a menu at position column 2 line 4 at a menu structure, it will be transmitted to nowhere.

- **Delete Menu** DEL_MENU

This function allows to delete the selected menu including the whole structure under it. It can be an APR layer only or submenus including all APR's.
The function offers all menus of a RGDV including an empty field on top. If this empty field will be transmitted with <F2> the complete menu/submenu/APR structure will be erased. After generator reset **test APR** will appear at the desk. This function should be used to clear a RGDV before new predefined APR data sets are loaded or the *'Accept' >> 'Restore'* (to reload backup files) function is used.

- **Move Menu** MOVEMENU

Menus or submenus can be moved within its layer to a free position (column and line), which has to be defined before. Moving menus to other RGDV's is not possible. Use **APRMAN**ager for an easier maintenance.

- **Rename Menu** REN_MENU

The menu name can be changed into everything desired (characters see doc INSTALLATION).

- **External APR Assignments**

- **Device Interface 1** only possible, if *'Release circuit adaptation unit'* is programmed as 1WA unit (jumper W1/W2/W3 open at WA backpanel)

RGDV key 1:		position **1**	**1 2** EXT_APR1
RGDV key 2:		position **2**	**3 4**
APR key 1...6	**(0 no APR):**	positions **3..8**	**5 6**
			7 8

It can be programmed with two of the activated RGDV's. Six APR of every activated RGDV can be assigned to the six buttons 3...8. To get the *'APR key'* numbers use *'Select APR'*.

The APR numbers must be entered at the RGDV # where they are assigned to. The two RGDV keys appear at all RGDV's.
If an assigned RGDV and/or an assigned APR is selected at the control desk, the RGDV/APR button will light up in the external APR module.

- **Device Interface 2** only possible, if *'Release circuit adaptation unit'* is programmed as 2WA unit (jumper W1closed, W2/W3 open at WA backpanel)

  APR key 1...8 **(0 no APR):** positions 1..8 = keys 1..8 EXT_APR2

  8 APR of each activated RGDV can be assigned to the 8 APR keys (>> max 64 !!).
  It is recommended to use one RGDV only.
  If an assigned APR is selected at the control desk, the APR button will light up at the external APR module.

- **Device Interface 3** only possible, if *'Release circuit adaptation unit'* is programmed as 1WB unit (jumpers W1/W3 open, W2 closed at WB backpanel)
  EXT_APR3
  With the **RGDV key 1** and **RGDV key 2** assignment the RGDV remote switch over inputs WB X21 pin 1 and 2 will be activated. The selected RGDV must get a low signal from the R/F controller, while the other RGDV signal must go high.

  !! Both keys **must** be programmed.

  8 APR of each activated RGDV can be assigned to the 8 APR keys (e.g. SCOPO) (max 64 !!).
  It is recommended to use one RGDV only.
  If an assigned APR is selected at the control desk, the APR button will light up in the external APR module.

- **APR modifiable by User** APR_MOD

  Yes = all data which can be overridden at the desk can be saved:
  push and hold the RESET labelled button, then push the overridden APR button, the asterisk indicating overriding disappears

  No = the save function after overriding is disabled, should be programmed if the MENU/APR structure is stable after a certain time or if there are 'gamblers' on site

  Note: In combination with *'Bucky Controller 1'* :
  If *'no'* is set one can see the following effect when carrying out the save function:
  Generator desk and the control handle display the APR which is assigned to **APR Program 1** at the control handle of the BDTH.

Optimus (XRG90) >> Adjust

- **Adjust**

  - **Tube Adaptation**

    The generator should be in ready condition. Select a RGDV with free cassette programming (no grid sync contact).

    The tube should be properly conditioned before starting the adaptation procedure.
    Break-in procedure see doc INSTALLATION chapter Tube conditioning.

    Note: Since release 5.x of Bucky controller **BuckyTH2** or Bucky unit for **easyDiagnost** the RGDV free cassette **RGDV4 TH2** or **RGDV8 easyD** *'Data Set A'* has to be set as follows (only these settings have to be changed):
    - Syncmaster present = **No**
    - Mounted radiographical controller = **none**

    Transmit the screen with <F2> and turn off the generator afterwards.
    Remove signal bus connection EZX23 from the backpanel.

    The tube adaptation includes
    1) the measurement the mA offset of the kV measuring circuit
    2) the measurement of the individual standby filament current
    3) the kV dependent filament / emission current bahaviour
    4) the boost adaptation to calculate the positive and negative boost (details see doc FAULTFINDING)

    in one procedure.

    The generator should be in a ready condition. Select a RGDV with free cassette programming (no grid sync contact).

    Press <RETURN>

    An opening screen asks to wait 20 seconds after the screen coming up thereafter has been <TRANSMIT>ted with <F2>.

    Tube: **1st Tube**
    2nd Tube
    3rd Tube

    Focus: **small**
    medium a tube with a (third) medium filament does not exist yet, it is **not** VARIOfocus
    large

    After <TRANSMIT> the green ready disappers from the desk for 20 seconds. The **Test** sign on the right side of the major exposure parameter display will change to **Adap**, normal exposure parameters like film-screen-combinations will disappear during a readaptation procedure to display **Adap**.

    Ready returns, the first data set **40kV 0.00mAs** comes up, which is the exposure data set to measure the mA measuring circuit offset.
    After about 30 sec **40kV 1.5mAs** will be switched for 6 seconds to measure the individual standby filament current.
    After 20..30 second a row of exposure with different kV stages are switched (about 120 / filament).
    4 min after start of adaptation the boost adaptation takes place. One exposure is for the positive boost (to measure the boost up time), the last exposure of the whole procedure is the negative boost (to measure the blank time). The tube will brake the last time, a beep at the PC and a window on the screen will ask to reset the generator.
    There is no exposure end beep during the entire adaptation procedure.
    During the adaptation it might happen, that the procedure stops for a while. The red light of the temperature traffic light turns on and warnings/error entries 00BV are logged. If the TTS (Tube

Temperature Supervision) sees a temperature in a critical range it will stop adaptation for a while to keep adaptation always in a 100% load range.

After adaptation followed by a generator reset all techniques are available and the **Test** sign disappears.

Both small and large focus must be adapted to use **VARIO**focus. APR using VARIOfocus can not be selected as long as both, small and large are not adapted.

- **CAN Auto Configuration**

  Start function: Update Generator Config:

  <OK> gives the command for CU to scan on the internal generator CAN bus and update the generator CAN member list (assign units on the list).
  Minimum configuration of an OPTIMUS (see also *'Faultfind - Power ON Results - Internal CAN Configuration'*:
  FU_mA (EZ119), **FU_kV** (EZ130), **FU_CU** (EZ139), **FU_CIE** (EZ150).
  If now an optional **F**unction **U**nit shall be added (e.g. FU_ADAP A = 1WA = PCB EWA102) this command must be given to announce this board on the CU CAN list.
  If a generator is getting a new (empty) PCB CU or the CMOS has to be erased for any reason CU updates the member list during the very first turn-on by itself.

  <CANCEL> or <ESC> nothing changes

- **Area Exposure Product** If the area dose shall be displayed at the control desk the option must exist (9890 000 0256x, see STAMMKARTE) in the function key EZ139 D38 (see *'Faultfind - Power ON Results - Options'*). The option requires the GALILEO collimator via *'Bucky controller 1'* or *'Thorav. / Dig. Bucky'*.

  Thoravision and Digital Bucky: The dose dose value is not displayed at the control desk, as the system controller takes the value and resets the value afterwards with the command **next patient**. The dose will be displayed on the images

  - **Specific Yield of Tubes**

    - **Specific Yield of Tube 1**...**3** SPEYIELD

      Procedure to measure and modify the specific tube yield see doc ADJUSTMENTS. The default yield data table is on the installation disk: **RE_YIEL.TDL**.

    - **Add Filter Correction Table** to adjust deviations of the default filter correction tables of the (additional) homogenous GALILEO collimator filters

      FIL_CORR
      - **2 mm AL** The default data table is on the installation disk: **RE_2AL.TDL**.
      - **1 mm AL + 0.1 mm CU** The default data table is on the installation disk: **RE_01CU.TDL**.
      - **1 mm AL + 0.2 mm CU** The default data table is on the installation disk: **RE_02CU.TDL**.

    - **Wedge Filter Correction Tables** to adjust deviations of the default filter correction tables of the GALILEO wedge filters (not yet available)

      WED_FILT
      - **Wedge 1** The default data table is on the installation disk: **RE_WED1.TDL**.
      - **Wedge 2** The default data table is on the installation disk: **RE_WED2.TDL**.
      - **Finger Wedge** The default data table is on the installation disk: **REF_FING.TDL**.

- **Dose Rate Control** >hardkey<

  - **TDC Amplimat** TDCAMPLI

p gain factor (def.50):	range = 0...100	defaut = 50
i gain factor (def. 8):	range = 1...100	default = 8
d gain factor (def. 5):	range = 1...100	default = 5
min sample time (def.40ms) [ms]:	range = 25...60ms	default = 40ms
mul. with gain factor 0.625...1.5 (def.1):	range = 0.625...1.5	default = 1

  - **Amplification gain** TDCAMGAI

    - **TDC** gain factor tomo density control

      gain factor 0.625...1.5 (def.1): range = 0.625...1.5 default = 1

    - **CONT** gain factor continuous fluoroscopy CONTGAIN

      gain factor 0.5...2 (def.1): range = 0.5...2 default = 1

    - **CONT kV mA manual** CONTKVMA

      LOCK IN: **LOCK** = for dose adjustment procedures, this function replaces the kv and mA potmeters
      automatically disabled after reset
      !!! If no link is inserted at 1WB X12:07 (DR_FL_LO_1) to :10 (GND2) the screen will be in *'UNLOCK'* condition when the screen is called again.

      UNLOCK = default or after soft reset or if no link is in at at 1WB X12:07 (DR_FL_LO_1) to :10 (GND2)

U[kV]:	range =	0...200 kV	default = 70 kV
I[mA]:	range =	0...2000 mA	default = 1 mA
		the value **must not** be **< 0.1mA** to prevent malfunctions of the generator	
DR set [µGy/s]:	range =	0.001...2.0	>> the '*****' appearing in these two fields
DR measured [µGy/s]:	range =	0.001...2.0	>> have to be replaced by a dose value

      >> Procedure for II input dose adjustments:
      set *'LOCK IN'* to *'LOCK'*, type in kV and mA values, type in DR (dose rate) values (use the same value for the first time), switch on fluoro, type in the measured DR value, <TRANSMIT> the data sreen, open the screen again - it will display a new mA value to achieve the required dose rate

  - **Boost Adaptation** >hardkey<
    Boost adaptation is part of the automatic *'Tube adaptation'* procedure. If it might be necessary (no reason known yet) this function can be used, normally: **ignore**.

INSTALLATION

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1. Installing the wall junction box

- Mount the wall junction box at the place where the generator is intended to be installed.
  (See drawing Z–3 in section 1 and manual UNIT 4512 103 75380 for wall junction boxes).
- If necessary, install the optional Surge Arrester WN inside the wall junction box.
  To do this see Surge Arrester documentation.
- If applicable, mount the filler panels of the generator to the wall junction box.
- Have the mains cable present at the clinic connected to mains terminal MEX by a person who is authorized for this job.
- Check the phase sequence of L1, L2 and L3.
- Switch off the mains supply present at the clinic and make sure that it cannot be switched on again by anyone who is not authorized to do so.

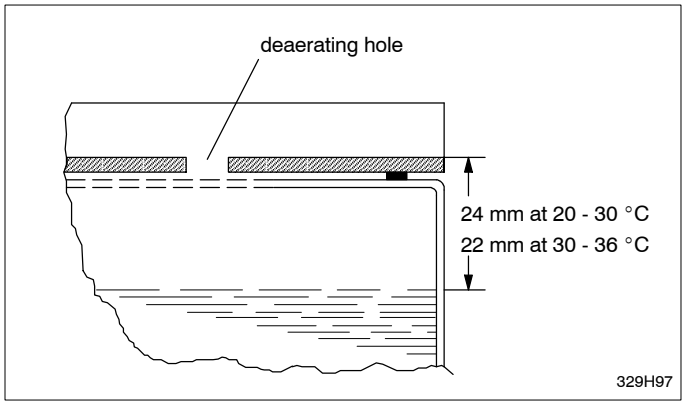
2. Mounting the H.V. generator in the cabinet

Caution!

Do not tilt the H.V. generator when transporting it!

In case a tilting angle of greater than 45° has been exceeded, the setting-to-work of the generator can be started not before a waiting time of about 8 hours has passed. Otherwise the H.V. generator may be destroyed by electrical sparkover!

- Unpack generator cabinet E.
- Unpack the H.V. generator.
- In case the packing material is strongly soiled with oil, check the oil level and, if necessary, correct.
  Watch that no foreign matter falls into the oil! Otherwise the transformer must be exchanged!
  Tolerance: ±2 mm
  Oil: Shell Diala G in 2.5 l container 4512 148 43172



- Remove the dearating screw completely from the cover of the H.V. generator. Only this way the precision of the high voltage measuring devider corresponds to the specification.
  In case of return shipment of the H.V. generator the screw must be fixed again. Therefore, keep the screw lying on top of the cover.
- Take the two transport bars from the rear side of the cabinet.
- Lift the H.V. generator into the generator cabinet with the transport bars.
  The 4 connecting bolts GX1001 to 1004 must point towards the front of the generator cabinet.

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- Connect the H.V. generator electrically.

Always:
- E1 ⏚ ——— GX1100 (ground)
- ZX12 ——— G100X15
- ZX35 ——— G100X14

Route the cables along the front and left-hand edge of the H.V. generator and fix them!

50 kW version:
- QC13:1 ——— GX1003
- QC 3:1 ——— GX1002

Twist the cables!

Bear in mind that the connecting bolts are not arranged in numerical order.

After connecting up, push the screening cap forward over the connecting bolts and tighten up. Attach the converter cables including the screening to the screening cap with cable ties.

Links or chokes of 1 ... 6 loops do not change:
- GX 1001 ------ GX 1003
- GX 1004 ------ GX 1002

50 kW version might have direct links on each side or a link on one side and a choke of 1 ... 6 loops on the other side for kV symmetry.

Don't change the links or chokes !

65/80 kW version:
- QC13:1 ——— GX1001
- QC 3:1 ——— GX1002
- 2QC13:1 ——— GX1003
- 2QC 3:1 ——— GX1004

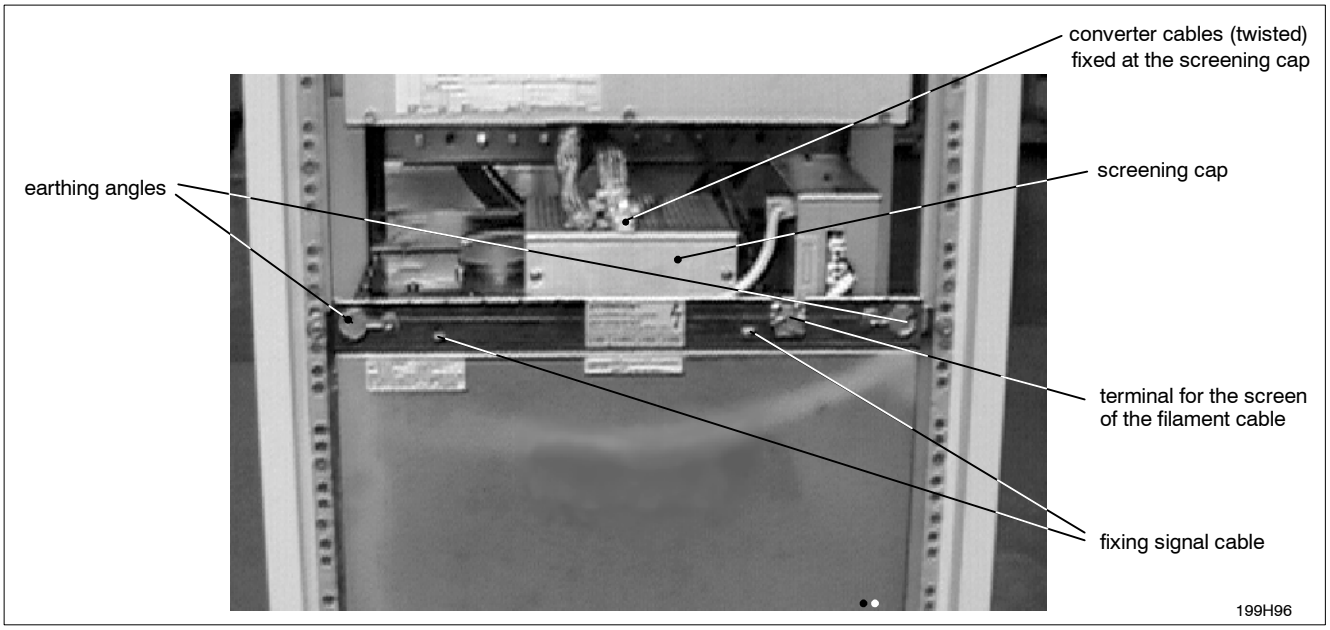
Twist the cables!

Bear in mind that the connecting bolts are not arranged in numerical order.

After connecting up, push the screening cap forward over the connecting bolts and tighten up. Attach the converter cables including the screening to the screening cap with cable ties.

2nd tube:
- WGX61 ——— GK1:1
- WGX67 ——— GK1:2
- WGX62 ——— GK2:1
- WGX68 ——— GK2:2

- Fold the two earthing angles of the H.V. generator outward and screw it on to the members of the cabinet.


converter cables (twisted) fixed at the screening cap
screening cap
earthing angles
terminal for the screen of the filament cable
fixing signal cable
199H96

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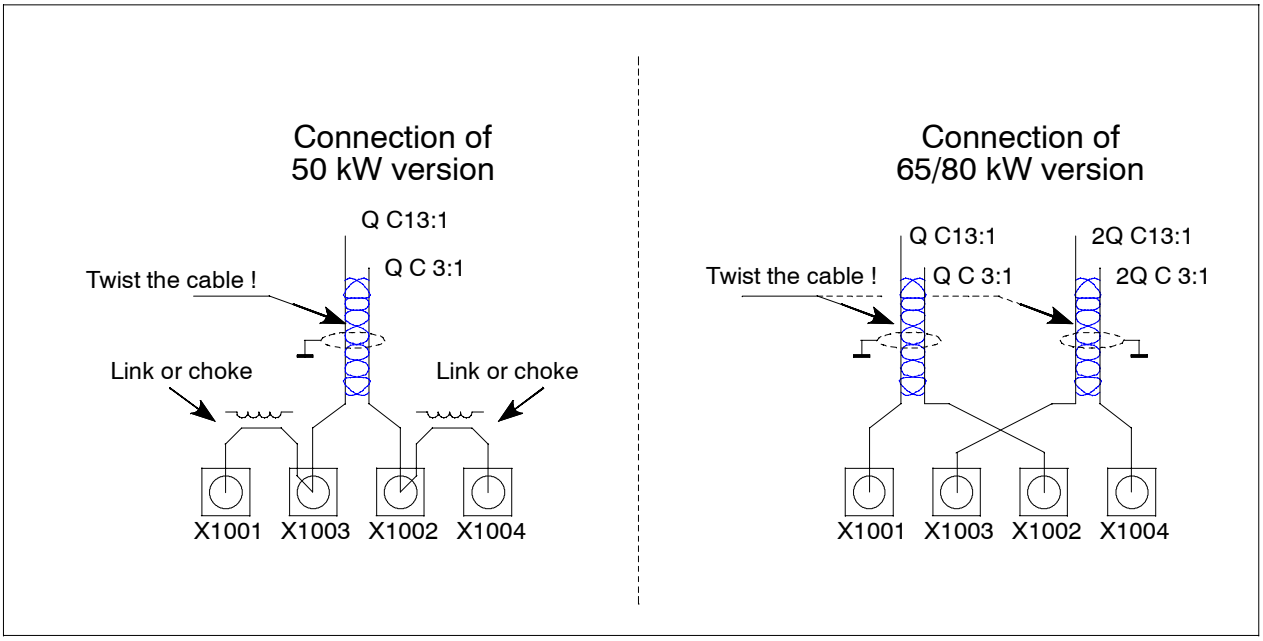


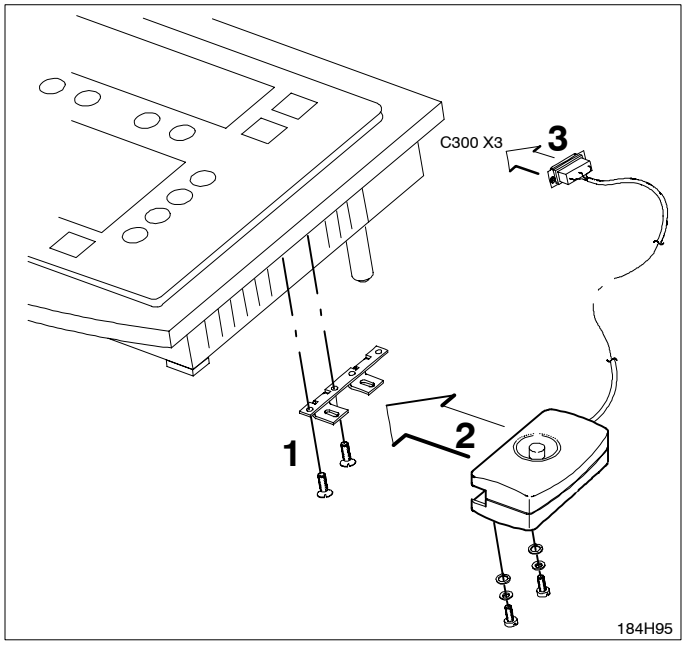
3. Installing the operating panel

3.1. Desk version

Accessories:

- 2 feet for the unit
- 2 elastic buffers, black
- 5 insert strips for the RGDV buttons
- sheet with RGDV symbols
- release switch

- Carefully unpack the desk.
- Mount the release switch on the left-hand or right-hand side of the desk.
  - Using the two M4x10 countersink screws attach the holding bracket to the edge of the desk (1). For visual reasons the release button should be in line with the +/- buttons on the control desk so please use the appropriate holes in the bracket.
  - Slip the release switch over the edge of the desk and fasten in position using the two M4x10 cheese-head screws, securing rings and washers (2).



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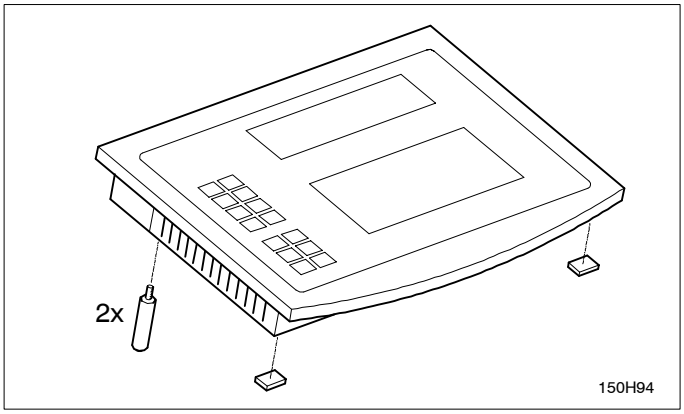
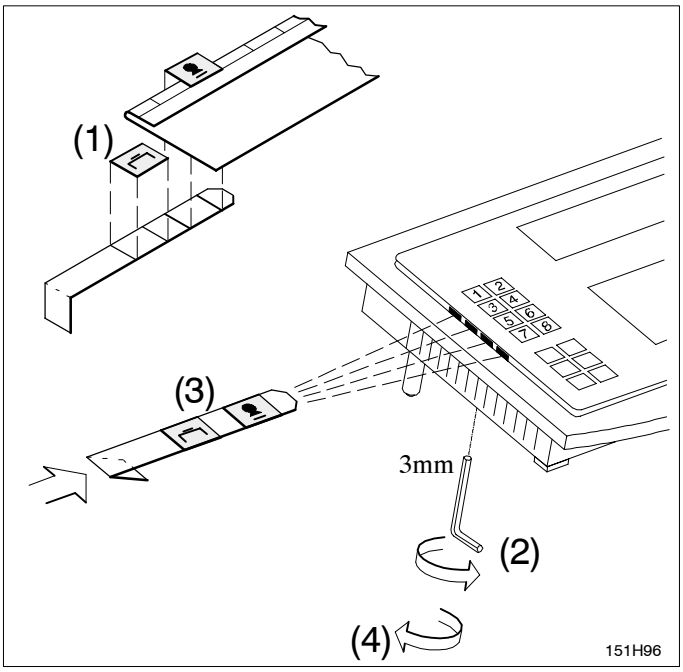


- Screw in the 2 feet for the unit at the bottom of the desk.
- Glue the 2 black elastic buffers to the front edges of the bottom of the desk such that they are acting as the front feet.



- Define the assignment of the RGDV buttons 1...8 and glue the respective symbols to the insert strips which are provided with subsidiary lines (1).
- Raise the keyboard from the bottom of the desk about 5 mm with an Allen key, 3 mm across flats (2).
- Push the insert strips under the keyboard foil. Press the angulated, protruding end of each insert strip into the housing of the desk (3).
- Lower the keyboard (4).
- Screw off the cable cover at the rear side of the desk..
- Connect the cables:
  - Supply cable EZX20 – C200X1
    EZX6 – earth
  - Data cable EZX46 – C300X1
  - Release switch – C300X3
  - Patient Data Organizer – C300X2 (option)
- Put the function programming plug for X44 into socket EZX44 or check it. (See also Z2-5.2).
- Provide drag relief for the supply and data cables with the clamp present on the desk.
- Screw on the cable cover. Make sure that the cable strain relief device of the release switch (1 cable tie) remains under the cover.

3.2. Stand version

See Z-5 "Operating panel" in section 1.

Additional accessories:
- 4 dowels S10
- 4 hexagon cap screws 8 x 60 mm
- 4 washers

- Position the desk stand according to the respective room layout.
- Mark the fixing holes on the floor.

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- Set the 4 dowels supplied into the floor (drill bit: 10 mm).
- Screw on the desk stand with 4 screws (13 mm across flats) and washers.
- Route the supply and data cables from the bottom to the top in the desk stand and provide the cables with drag relief. Cable ends including plugs should protrude beyond the edge of the desk by about 500 mm.
- Mount the release switch as described under 3.1.
- Assign the RGDV buttons 1...8 with the desired symbols as described under 3.1.
- Connect the cables to the desk as described under 3.1.
- Screw on the cable cover. Make sure that the cable strain relief device of the release switch (1 cable tie) remains under the cover.
- Attach the operating panel on the stand.

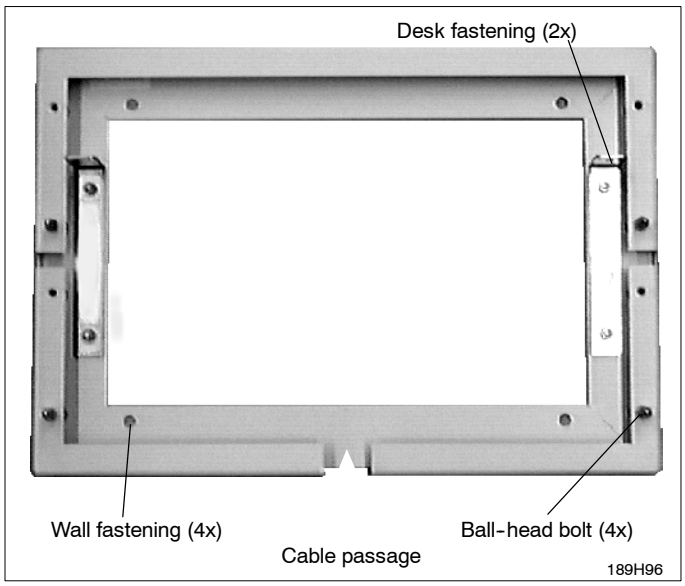
3.3. Wall mounted version

See Z-5 "Operating panel" in section 1.

Additional accessories:

- 4 ball-head bolts
- 4 dowels S8
- 4 hexagon cap screws 5 x 30 mm
- 4 washers
- 2 screws 4 x 10 mm
- 2 angle plates
- 4 nuts

- Screw the angle plates into the wall frame.
  The short ends of the angles must be pointing upwards.
- Screw the 4 ball-head bolts into the wall support.
- Mark the 4 fixing holes of the wall frame at the respective place on the wall.
- Set the dowels supplied into the wall (drill bit: 8 mm).
- Screw on the wall frame with 4 screws and washers.
- Provide drag relief for the supply and data cables in the wall frame. Cable ends including plugs should protrude beyond the edge of the desk by about 500 mm.
- Mount the release switch as described under 3.1.
- Assign the RGDV buttons 1...8 with the desired symbols as described under 3.1.
- Connect the cables to the desk as described under 3.1.
- Attach the operating panel on the wall frame and fix it with two screws.
- Screw on the cable cover. Make sure that the cable strain relief device of the release switch (1 cable tie) remains under the cover.



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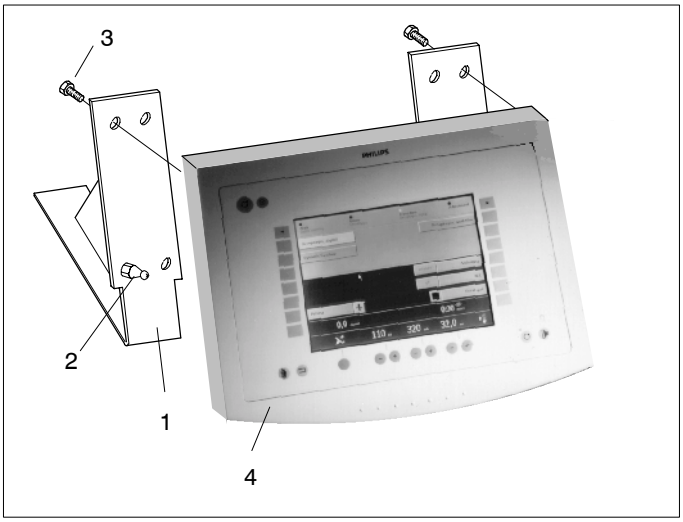
The wall frame is of symmetrical design. If surface-mounted cables to be connected come from above it can be fitted upside down. The ball-head bolts and the angle plates must then be fitted appropriately at different positions.

3.4. Supporting angle version

- Screw the ball-head bolts (2) into the supporting angles (1):
  - Left angle : on the left at the bottom
  - Right angle : on the right at the bottom
- Press the ball-head bolts (2) into the respective snap bushing of the Cockpit (4).
- Fix the supporting angles (2) to the Cockpit (4) with the screws M4 (3).



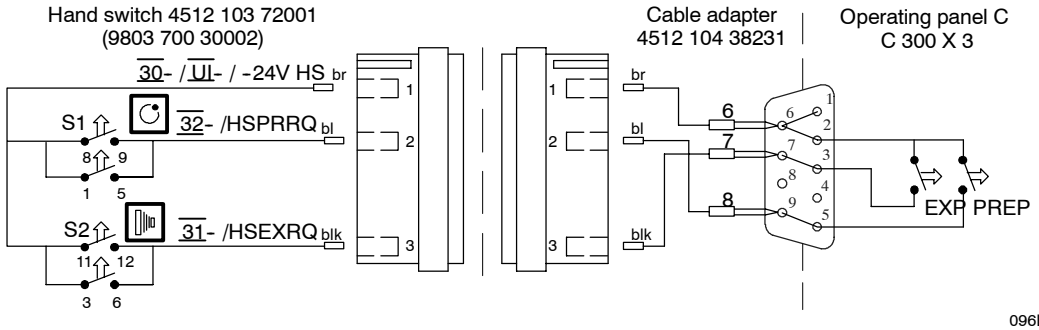
3.5. Additional release switch (9890 000 0249x)

An optional second release switch is supplied with a longer spiral cable. The scope of delivery includes various wall hooks and an adapter cable. Electrical connection is made in parallel with the existing release switch which is mounted on the desk itself. To do this, plug the pins of the adapter cable into the D-Sub connector of the existing release switch.

Sequence: Adapter connector pins 1-2-3 to D-Sub connector pins 6-9-7

Reference: Drawing Z1-11.1

Hand switch with adapter (9890 000 02491)



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4. Electrical connection

4.1. Earthing

See ”Earthing diagram” in section 1.

4.2. Mains connection

See Z-7.1 ”Connection diagram” in section 1.

- Measure the internal mains resistance at the terminal MEX with a suitable measuring instrument.

  L1-L2: R_i= ..... mΩ

  L1-L3: R_i= ..... mΩ

  L2-L3: R_i= ..... mΩ

  Required max. mains resistance at generator input :

Mains voltage	30 kW	50 kW	65/80 kW
190 V *		40 mΩ	-
220 V *	130 mΩ	60 mΩ	-
240 V *	160 mΩ	80 mΩ	-
400 / 440 / 460 / 480 V	500 mΩ	300 / 350 / 350 / 400 mΩ	200 / 240 / 240 / 300 mΩ

  * with external mains transformer

  Maximum permissible internal mains resistance: 500 mΩ

  Internal resistance of Power Distribution Unit (PDU): 20 mΩ at 50 Hz
  23 mΩ at 60 Hz

- Switch off the mains supply present at the clinic.
- Connect the mains cable of the generator to terminal MEX:L1/L2/L3 at the wall taking care that the phase sequence is correct.
  If the Power Distribution Unit is fitted, connect the cables at that point up to terminal WTX2.
- Connect the examination unit supply (max. 10 A) to (230 V / 400 V):
  - Output 1 : Geometry power : EN X2101/...5
  - Output 2 : I.I./TV, GECO, UI, SYSCO : EN X2201/...9
  - Output 3 : Imaging : EN X2301/...9

    Output 3 not switched by the generator

4.2.1. Mains connection of the Power Distribution Unit (PDU) WT

See Unit Manual Power Distribution Unit

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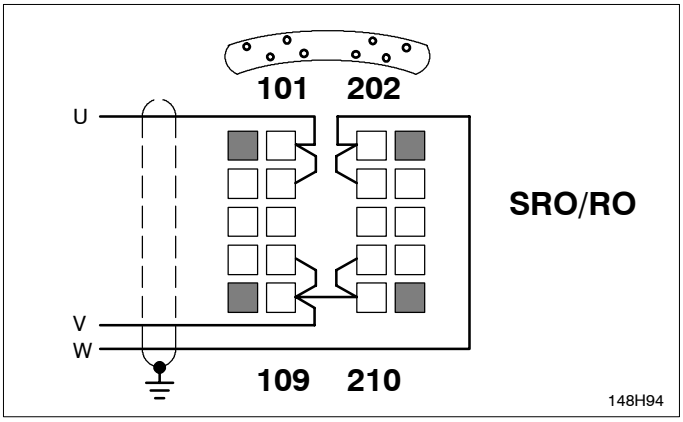
4.3. Stator connection

At the tube end:

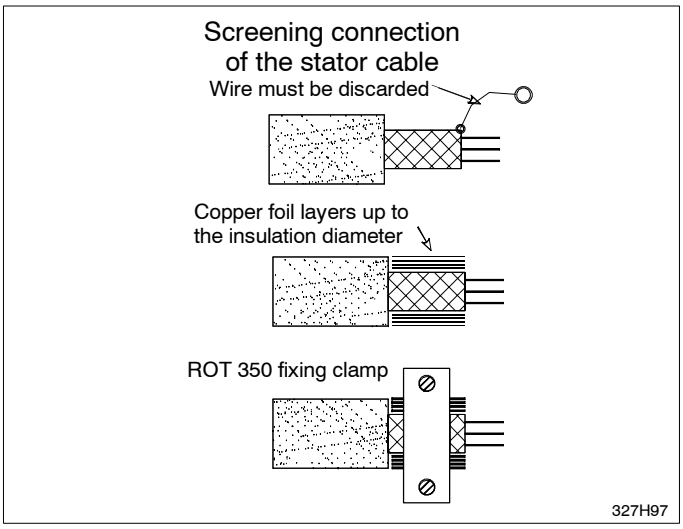
- Place the jumpers across terminals 100 and 200 accordingly.
- Connect up stator cable.
  Use wire 1 for phase U,
  wire 2 for phase V,
  wire 3 for phase W.
- Earth the screening of the stator cable at the tube housing with the clamp.



Caution!
To suppress interferences of the high-speed rotor control, the stator connection must also be provided with a 360° screen at the tube and generator end!

To do so proceed as follows:

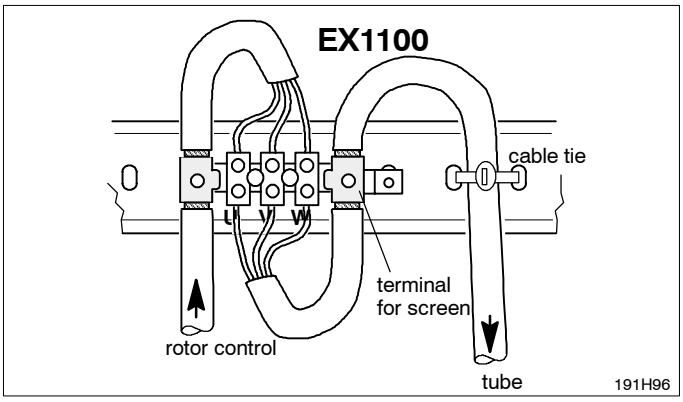
- Remove any enamel or dirt from the clamp providing drag relief in the tubeshield to make sure the clamp is conductive.
- Stator cable at the tube end: Remove the plastic covering around the clamp (about 1 cm/0.5 inch).
- Wrap copper foil around the visible screen of the cable until the original diameter of the cable is obtained.
- Remove the present red wire going from the screen end to the earthing point of the tubeshield.
- Fix the screen of the stator cable with the clamp. Make sure that the clamp is secured and the ground contact ensured!



At the generator end:

See Z-7.1/2 ”Connection diagram” in section 1.

- Connect the stator cable to the terminal EX1100 (U-V-W) or the stator contactors of the tube extension EWG if present.



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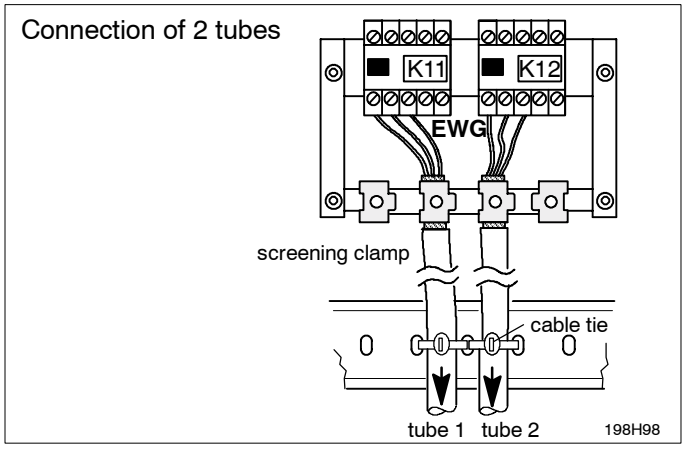
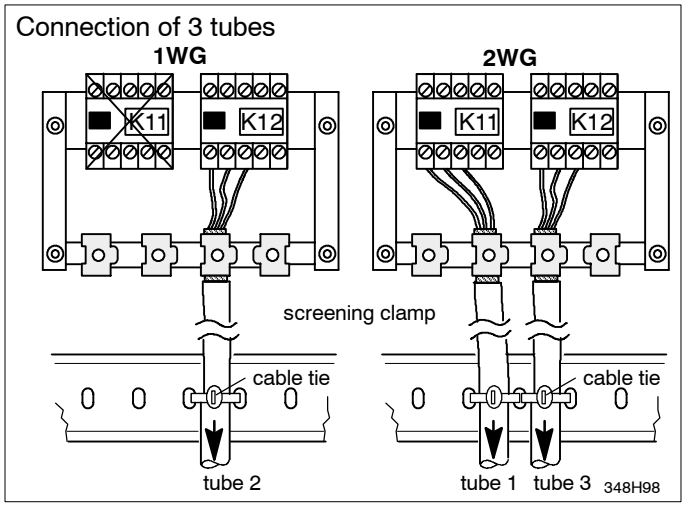
- Check the stator connection by measuring resistance.
  U-V = wire 1 – 2 ≈ 11 Ω
  U-W = wire 1 – 3 ≈ 20 Ω
  V-W = wire 2 – 3 ≈ 9 Ω
- Relieve the tension on the stator cable with a cable tie.

Note

- *Use screened cables. Connect the screen to earth at both ends.*
- *Do not mix up the phases, for otherwise components of the rotor control may be destroyed.*
- *Shorten the stator cable to the required length. Do not accommodate excess lengths at the generator.*
- *Keep stator cable separate from all the other signal cables to avoid interference.*





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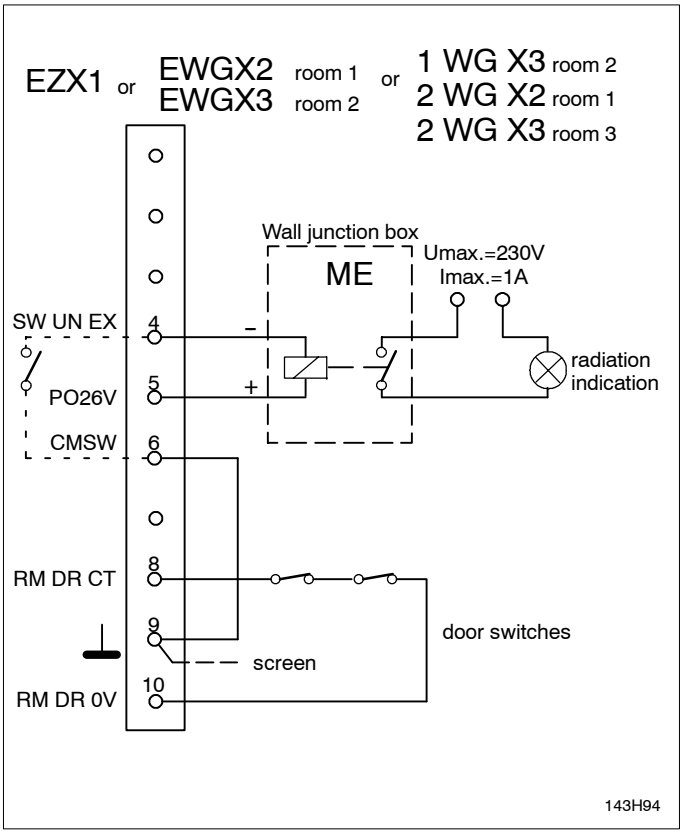
4.4. Signal cables

See ”Connection diagrams” in section 1.

4.4.1. Room decade cable

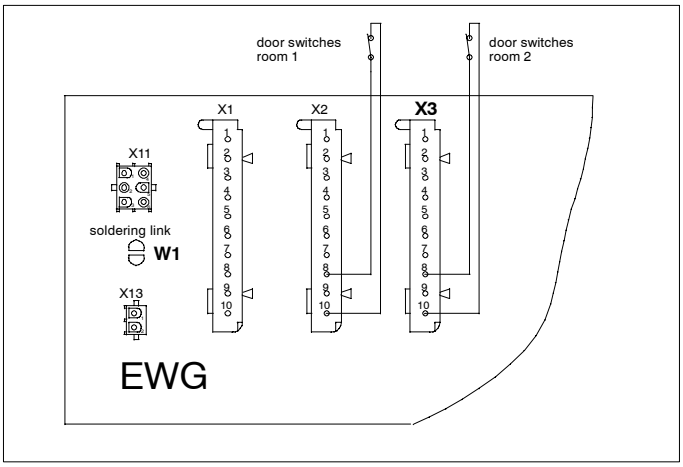
- Connect the door switches at the generator:
  EZX1/EWGX2/EWGX3: 8 -- switch --> 10
  or
  EWBX22 8 -- switch --> 10
  If none present, link pins 8 - 10.
  See also: Z1-6 ”Basic interface”.



- In case tube 2 or 3 is located in room 2 or 3 or when room decades
  - WG X3 or
  - 1WG X3 or
  - 2WG X3

  are intended to be used for room supervision, soldering link
  - WG W1

  must be placed.
  Only when this link is placed it is guaranteed that relay WG K3 pulls up and room decade WG X3 is activated when switch-over of the tube takes place.
  Also see Z1-14.xx ”Tube extension”.



- In case of need connect an external relay for each examination room to control external radiation warning devices.
  One relay inclusive cable is part of delivery.
  A mounting place is reserved on the mains connection terminal MEX of the wall junction box.
  Make sure the polarity of the relay is correct.

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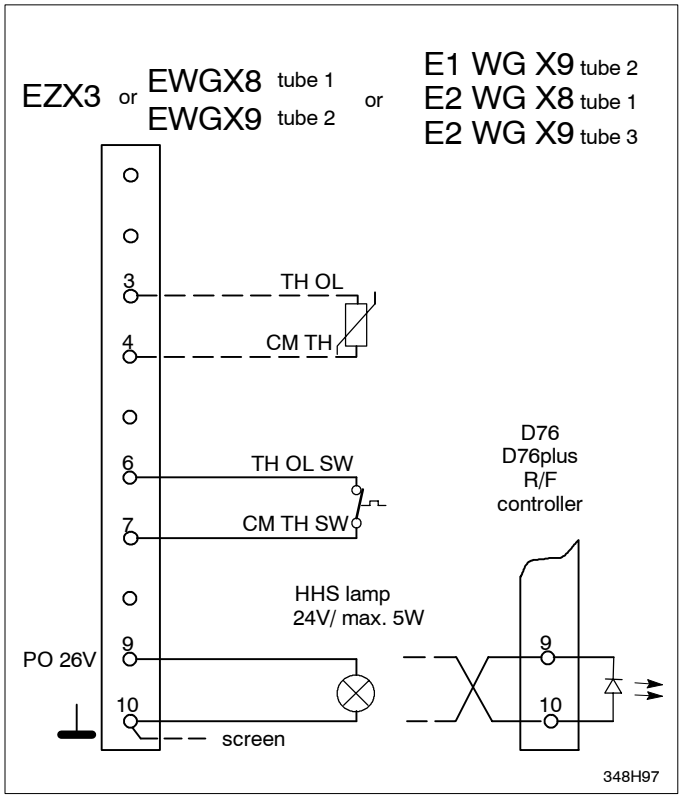
4.4.2. Tube supervision

- Connect the thermal switch or the thermal sensor of the tube housing assembly.
- For U.S.A. and U.K. only:
  Connect the HHS-lamp to indicate the selected tube housing assembly.

Attention!

When a D76 or D76+ system is connected, a LED is controlled by contacts 9/10 with the specified polarity.

Therefore connections 9 and 10 of the decoder cable must be interchanged.



4.4.3. CAN interface

For examination units which are provided with a CAN system interface.

- EZX 23 - signalbus
- EZX 43 - system CAN

4.4.4. Adapter for 4 auxiliary units

For examination units which provide their control signals individually via decade cables.

Each of the release circuits and bucky decades can be assigned to one or several of the RGDV buttons 1...8 via software programming.

Survey: 1Z-7.x "Connection diagram"
Z1-1.2 "Block diagram, expansions"

Detail: Z1-15.1 "Adapter 4 aux. units"

Information about assignment of the bucky decades WAX11/12:

- The Bucky decades have to be assigned only if any of the following inputs are to be used:
  1–2 format contacts Switch the external measuring fields ON/OFF
  3–4 tomo mode bucky – tomo switchover
  5–6 tomo ready tomo condition met
  9–10 bucky ready bucky condition met
- The inputs are only activated by SW programming (see 9.5).
- After activation via the SW any missing inputs not being provided from the stand must be simulated by jumpers.
  Example:
  Format contacts on WAX11/12:1–2.
  The outer measuring fields can only be selected in the closed state.

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4.4.5. Dose inputs

- Connect the measuring chambers to the D-Sub connectors EZX21/22/31/32/41.
  There are no restrictions on assignment because the measuring chambers are assigned to the auxiliaries in SW programming.
- At the junior/extremity measuring chamber withdraw pins 101–102–103 or A–D–H for measuring field selection.
  These measuring chambers have only one measuring field. The terminal for the left-hand field is used in other configurations for switching over intensification and must not be connected up here.
- Connect the photosensor dose output of DSI from Central Part E (BHX 12) to EZX41. Only EZX41 sends the necessary signal REL (or REL_CH ≙ RELease CHamber) for automatic and non-automatic techniques.

Attention:

AMPLIMAT cables 9803 507 0xx02 (for hybrid–measuring chambers 9803 509 xxxxx)

with 3PLUS plugs at both ends **must** be connected in the generator via the following adapter for each cable:

Adapter for AMPLIMAT cable 4512 108 09042.

The generator includes 1 adapter.

The hybrid measuring chambers 9803 509 xxxxx require connection (chassis) between contacts

Sub–D end GND (13) --- RF 0V (8) (generator input)

or

3PLUS end GND (N) --- RF 0V (J).

This connection is established with the adapter for the AMPLIMAT cable (also see Z1 ”Basic interface” of the generator manual).

In case a hybrid measuring chamber 9803 509 xxxxx is **not** operated with the required

AMPLIMAT cables 3PLUS / 3PLUS: 9803 507 0xx02

but with

AMPLIMAT cables D–Sub / 3PLUS: 9890 000 017xx

make sure to establish this connection (13---8) in the sub–D connector!

For ALC measuring chambers 9890 000 016xx connection GND --- RF 0V is not permitted.
Therefore, for ALC measuring chambers AMPLIMAT cables 9890 000 017xx should always be used.

4.4.6. Dose rate input

- Connect the dose rate output of TV chain for fluoroscopy at EZX61.
  Use the I.I./TV adapter on EZX61.
  See also Z1–5.1 ”Central unit”.

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4.4.7. Patient Data Organizer PDO (option)

See operator's manual Patient Data Organizer.

4.5. H.V. cables

See 1Z-7.x "Connection diagram" in section 1.

- Mark the H.V. cables at the generator and the tube end with the correct polarity.
- Fix the H.V. cables on the left-hand side of the wall junction box on the middle rail for providing drag relief for the cables. The short ends of the H.V. cables which are going to the H.V. generator must be routed in downward direction in this area.

  The free cable lengths including plugs should be about 1.5 m.
- Twist the H.V. cables counter-clockwise by one turn and connect them to the H.V. generator.

  The twisting of the cables provides that the H.V. cables can be put into a loop when the cabinet is placed against the wall.

  The H.V. sockets should always be filled with some oil. At least the lower half of the plugs must be wet with oil.

  Do not fit a silicone washer.

  Do not rub them with silicone paste.

Notes

- *The union nuts of the high-voltage connectors must be tightened up to ensure good electrical contact for screening.*
- *Only high-voltage connectors which have threaded flange halves may be used. Older high-voltage cables still have connectors where the flange halves are kept together with a spring washer.*
  In such cases the modification kit 4512 103 80852 will be required.

4.6. EMERGENCY-OFF circuit

- Connect the EMERGENCY-OFF buttons to EZX4:1/2.
  If not necessary, link pins 1 - 2.

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5. Hardware programming

On PCB EZ150 Basic interface:

- Voltage supply for the amplifiers of connected measuring chambers:

Voltage\Soldering link	EZ 150 W2	EZ 150 W3
15 V default	OFF	ON
40 V	ON	OFF

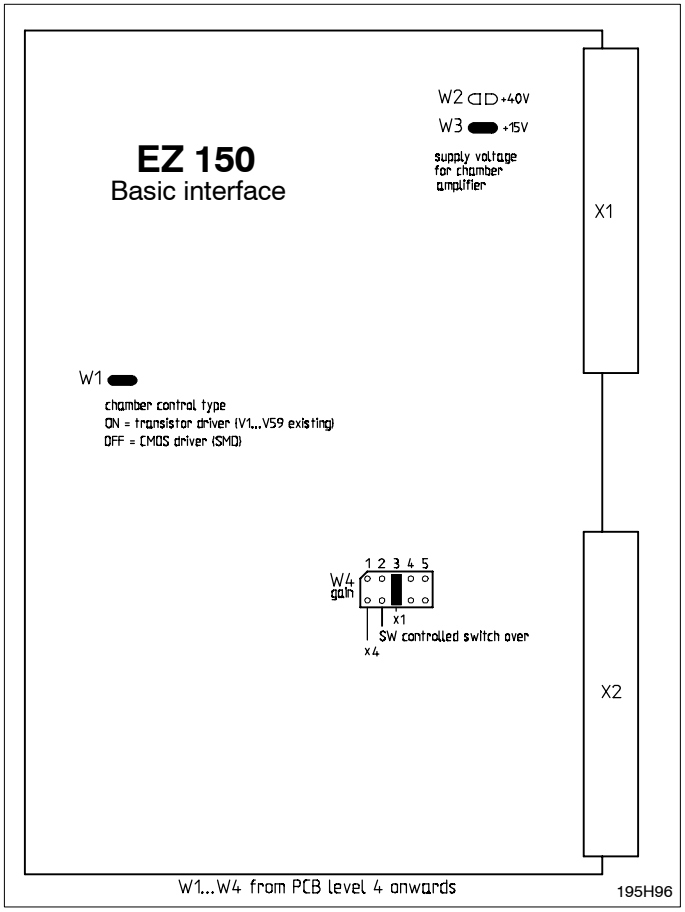
  - Working voltage range for ALC measuring chambers: 15 ... 45 V
  - Working voltage range for Hybrid measuring chambers: 40 ... 45 V

  ALC measuring chambers can be recognized from the code No. 4512 104 xxxxx, hybrid measuring chambers based on code No. 4512 102/103 xxxxx.

- Set gain factor for AEC techniques with jumper EZ150:W4:
  - Factor 1 = W4 in position 3 = default
    For film/screen combination with at least one system speed
    $\preceq$ 200.
  - Factor 4 = W4 in position 1
    For film/screen combinations with all system speed
    $\succeq$ 200.

The rest of the generator hardware has been properly programmed at the factory.

If required, refer to section ”Programming”.



6. Switching on the generator

- Switch on the fuses present at the clinic.
- Switch on automatic circuit-breakers ENF1, ENF2 and ENF3.

  The yellow LED on EN100 POWER ON CIRCUIT must be illuminated.

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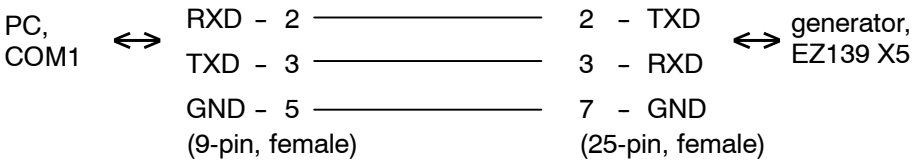
7. Using the installation software XRGSCOPE

- Provide the service PC with the hardware key and switch it on.
  The hardware key provides access to special program settings and to menu ***"Faultfind".***
  Standard programming is possible without a hardware key.
- Switch the generator on.
- Connect the PC to X5 on EZ139 CENTRAL UNIT CU via a serial data cable.



Note

Whenever using XRGSCOPE, start from DOS if possible. Using WIN95 might cause some unexpected problems (WIN3.x also) depending on the number of multitasking backround programs. XRGSCOPE runs best under pure DOS. If it runs in a DOS-box under WIN3.x, the file dosprmpt.pif (or possibly a special selfmade xrgscope.pif) should be setted to exclusive and full-screen-mode, wich can be done with the PIF-EDITOR.
XRGSCOPE is not tested with WIN95. In case of problems they may be solved if WIN95 is started in MSDOS-MODE. To ensure save loading procedures from and to the generator screensavers and any kind of power management must be switched off. These should never be active when using XRGSCOPE.

- Insert the floppy disks containing the self-unpacking exe-files of the firmware in the disk drive of the PC:
  - OMA : 4512 116 022xx
  - OMB : 4512 116 023xx .

  For unpacking on the fixed disk of the PC about 5 MB are needed.
- Generate a directory (e.g. C:\OPT_R_3) on the PC (md C:\OPT_R_3).
- Copy the firmware from both floppy disks to the PC into the same directory C:\OPT_R_3 (copy A:*.* C:\OPT_R_3).
- Start unpacking programs OMAxxxxx.exe and OMBxxxxx.exe.
  The programs unpack all files needed for the update of the firmware and the newest service tools.
- After unpacking OMAxxxxx.exe and OMBxxxxx.exe can be deleted.
- For further installation of the firmware in the generator read README.txt.
- For the current contents of OMA/OMBxxxxx.exe read OMA/OMBxxxxx.txt on the floppy disks.
- For a new installation of the generator firmware see "REPLACEMENT" chapter "Exchange of firmware ...".
- Call the installation program with ***xrgscope*** or ***xrgscope lcd*** for PCs with LCD screen.

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WheneverXRGSCOPE is started, the program will first of all display the screen CUSTOMER.TDL (with data what is actually stored in CUSTOMER.TDL).
Whenever data screens like *'error log index'* are saved to a xxx.TDL file (function **Save: <F3>** appears in the bottom line), *'customer data'* being saved in theCUSTOMER.TDL file are attached to the saved data screen. It helps to seperate saved screen files of different sites, customers or rooms in the same hospital.
Site data must be stored in CUSTOMER.TDL file, only data of this file are attached to the saved screens. One can save site specific customer data in self-made files using <F3>. To recall site data use the **Load: <F4>** function. It does not appear in the bottom command line, but it is possible to do so.
Procedure: Either the CUSRTOMER.TDL screen is open or open the *'Customer Data'* screen. Push <F4> and select a site data file. The old data screen comes up. Now save this screen with <F3> typing in CUSTOMER as file name.

- **Customer Name:**
- **City / State:**
- **Country:**
- **Generator Location:**
- **Generator Serial Number:**
- **Generator 12 NC:**
- **Memo1:**
- **Memo2:**
- **Memo3:**

After <Ecs> the following menu line appears:

File	***OPTIMUS***	***Select Unit***	***Options***	***Help***

- Select "OPTIMUS".
  The following menu line appears:

Program	***Adjust***	***Accept***	***Faultfind***	***Quit***

General information:

–	Button F1	<help>	Call help/cancel help.
–	Button F2	<transmit>	Store screen contents/data set in the generator transmit to generator.
–	Button F3	<save>	Store data set on disk; the path desired can be selected.
–	Button F4	<load>	Load data set from disk; the path desired can be selected.
–	Button Esc		Commands one step back; can be used repeatedly.
–	Fields with ↓		Select the possible range of values with the RETURN button = ↵. The data are specified by the generator as fixed values.
–	Fields with [...]		Input of data via the keyboard.

Error numbers which appear at the beginning of the programming procedure must be erased from the screen with the RETURN button.

Note

- *Current data files, for instance, for online help, tube types, APR programming are available in BBS.*
  Product: Generatoren Hamburg
  Download area: OPTIMUS
- *If you call the installation program with **xrgscope ?** the possible starting parameters for the service program will be listed.*

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8. Setting-to-work overview

This overview shows in what order the programming of a generator should take place.
The methods of programming are described in the following sections.

- Generator ON

1. - Program ... *Date and time*
   Mains data
   Tubes
2. - Program ... *Registration devices/ RGDV 1...8/ Data set A ... B*
   Registration devices/ RGDV interface assignment
3. - Reset the generator *with ON button at the desk or S1 on PCB EZ139*
4. - Conditioning the tube
5. - Adjust ... *Tube adaptation (all foci)*
   - Reset the generator
6. - Program ... *Dose Rate Control/ AMPLIMAT/ Chamber 1...5/ Data set 1...5*
   - Reset the generator
7. - Program ... *Application limits*
   - Reset the generator
8. - Program ... *Human interface/... --> All changes will be visible after a reset*
   ... /Select language
   ... /RGDV related assignment/ RGDV 1 ... 8/ Predefined assignment
   - Reset the generator
9. - Density correction *Dose Rate Control/ AMPLIMAT/ Chamber 1...5/ Data set 1...5* -manual programming
10. - Adjust ... *Area Exposure Product/...*
    .../ Specific yield of tube 1...3
    .../ Add filter correction tables
    .../ Wedge filter correction tables (not used at time)
11. - Accept... *Backup*

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9. Configuration

9.1. Date and time

- Select menu "*Program/* ***Date and Time***".
- Enter the respective local data.

9.2. Mains data

- Select menu "*Program/* ***Mains Data***".
- Select the nominal value of the mains voltage U. Range: 380 V, 400 V, 440 V, 480 V Default: 400 V
  If 460 V is present program 480 V.
  If 415 V is present program 400 V.
- Enter the maximum internal mains resistance R_i. Range: 0...500 mΩ

Depending on the internal mains resistance and the mains voltage the generator calculates the maximum possible output.

9.3. Tubes

9.3.1. Tube data set

Note
During this procedure the CAN interface on EZX43 must be disconnected if present (THORAVISION or Bucky TH with bucky controller).

- Select menu "*Program/ Tubes/ Tube 1...3/* ***Tube 1...3 Data Set***".
- Start the displayed file *tubexxx.tdl* with <Return>.
  All the permitted combinations of tube type and housing type are listed in a window.
- From the list select the respective combination of tube type and housing type and press <Enter>.
- Reset the generator with the ON button at the desk or button S1 on PCB EZ139.
  Then the data which have been configured up to now are read by the processor when the system is started.

9.3.2. Tube speed selection

Depending on the type of tube loaded the set speed for the anode is programmed automatically.

Modifications, if necessary, may only be performed if a hardkey is used on the PC.

Caution!
Wrong programming could destroy the rotor control unit.

- Select menu *"Program/ Tubes/ Tube 1...3/* ***Tube 1...3 Speed Selection***".

RPM \ tube type	RO	SRO
Exposure rotation [RPM]:	3000	9000
Fast Exposure rotation [RPM]:	3000	5600
Fluoroscopy rotation [RPM]:	3000	3000

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9.3.3. Tube limits

- Select menu *"Program/ Tubes/* ***Tube Limits****"*.
- For each tube connected, program the maximum working voltage which is indicated on the data label:

  Max. Tube Voltage Limit: default: 150 kV range: 40...150 kV

  Adaptation of the tube is up to this limit.

  If older tubes are to be operated on this generator, it is urgently recommended that the maximum kV used in practical operation so far be specified instead of the theoretically possible value.

  After adaptation of a tube the upper kV limit is displayed for each focus of each tube under:

  Adapted to [kV]: e.g. 125

All the other limit programmings are performed by the generator automatically and do not usually have to be observed.

9.3.4. Capacitance of tube connection

- Select menu *"Program/ Tubes/* ***Capacitance tube connection****"*: Tube 1...3 range = 2.000nF – 10.000nF.
- The total capacitance for each tube connected is indicated.

  $C = \frac{1}{2} \left(C_{H.V.\ generator} + C_{H.V.\ cable} \right)$

  $= 4.550$ nF Default for H.V. generator + 20 m H.V. cable (155pF/m)

  $C\ [nF] = 3 + \frac{C_c \times L}{2000}$ C_c = specific cable capacitance in [pF/m]
  L = single cable length in [m]

  Example for "capacitance tube connection" in [nF]:

L[m] single length	for 155 pF/m cable	for 200 pF/m cable
14	4.085	4.400
16	4.240	4.600
18	4.395	4.800
20	4.550	5.000
22	4.705	5.200
24	4.860	–
26	5.015	–
28	5.170	–
30	5.325	–

The high-voltage cables type 9806 402 6xx02 currently being supplied have a capacitance of 155 pF/m.

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9.3.5. Tube operating modes

- Select menu *"Program/ Tubes/* ***Tube Operating Modes****"*.

  - Intermediate boost:

    Select ... Disable = During preparation the rated filament current is applied (default).

    Enable = During preparation a reduced filament current is applied.
    After the release of exposure boosting takes place for a short time before the exposure is released. Effective with tube currents > 80% of max. value.

  - Rotation prolongation after PREP:

    Disable = The tube is braked as soon as Preparation has been cancelled.

    Enable = After cancellation of Preparation the tube is only braked after 30 s. Within this time Preparation can be repeated as often as necessary. Recommended for paediatrics and casualty rooms.
    Only with High Speed Rotor Control.

9.3.6. Disable tube

For correction of the configuration.

- Select menu "*Program/ Tubes/* ***Disable Tube****"*.

When the tube is disabled the above stored data set of the tube is erased. To enable the tube the tube data set has to be loaded again.

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9.4. Dose rate control

9.4.1. AMPLIMAT sensitivity

- Select *"Dose Rate Control/ AMPLIMAT/* ***Sensitivity****".*
- Depending on HW programming of jumper EZ150: W4, program sensitivity accordingly:
  high = × 4 = EZ150: W4 in position 1 = All Film/screen combinations with a system speed of over 200.
  low = × 1 = EZ150: W4 in position 3 = Film/screen combinations at less then 200 at least one.

9.4.2. Film/screen combinations

5 film/screen combinations can be programmed for each of the 5 measuring chambers:

- Select menu *"Program/ Dose Rate Control/ AMPLIMAT/ Chamber 1...5/* ***Data Set 1...5****".*
  The number of the chamber corresponds to the specified unit number of the dose measuring unit.

The choice between automatic and manual DRC processing is possible when an authorized hardware key is inserted in the PC.

Automatic is selected as default and must be used for the initial programming.

Access manual DRC processing by pressing the Esc key.
The manual mode is suitable for:

- Copying complete programming to other measuring chambers
- Setting the basic density
- Changing the desk-displayed names of the programmed film-screen combinations
- Creating backups of the DRC programmings

Automatic DRC processing:

- Select the desired data from the files offered for the following programming steps.
  The files are part of the installation software.
  - Select the programming field with the cursor and enter <Return>.
  - Enter the desired file from the list offered.
  - Select the desired data as required.

FILM	File "film.tdl":	Film types according to description of the manufacturer.
	File "film_bl/ _gr/ _uv.tdl":	General classification of the film according to color, sensitivity S and RLF compensation.
SCREEN	File "screen.tdl":	Screen types according to description of the manufacturer.
	File "lumat_lg.tdl":	Screen types according to luminous matter.
CHAMBER	File "chamber.tdl":	Different types of measuring chambers.
CASSETTE	File "cassette.tdl":	Different types of cassettes.
SYSTEM CORRECTION	File "syscor.tdl":	Select "no corr. (ISO 9236-1)".
CORRECTION FACTOR	Default: 1.0	Correction factor for switch-off dose.

Based on the combination of the components entered, the processor calculates the switch-off dose, kV correction and RLF compensation and creates a name for the film/screen combination, e.g. "B400".

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Since the data selected are not directly stored in the generator, it is recommended that they be entered in the following table ”Data sets of chambers” 2Z-4.

- Reset the generator.

Color and sensitivity class of the film/screen combination are displayed on the desk, for instance, B 400.
The other film/screen combinations (data set 1...5) for the chamber can be selected with the ± buttons.

Manual DRC processing:

The current data set of the film/screen combination is displayed.

Abbreviation:	Abbreviation for the film/screen combination. Example: B400 = blue, intensification 400.
Dose Request Chamber:	Parameter of the measuring chamber type in [µGy/V].
Dose of FSC:	Switch-off dose of the film/screen combination in [µGy]. Linear ratio with respect to the film density.
kV70-Char. U_0...9:	Checkpoints for kV-dependent density correction.
kV70-Char. Drel_0...9:	Relative correction value for the dose.
RLF t_0...9:	Checkpoints for time-dependent density correction (RLF).
RLF Drel_0...9:	Relative correction value for the dose.

- If required, change the data and the abbreviation name.
  Usually no value except the basic density ”Dose of FSC” must be changed (see chapter 13.)
- Transmit the data set with F2.
- Reset the generator.

The SAVE (F3) and LOAD (F4) functions of ***XRGSCOPE*** permit straightforward copying of the measuring chamber programmings.

9.4.3. Image Intensifier (II):

- II lead time
- Density voltage correction (default 1V)
- Dynamic factors

9.4.4. Fault exposure detection

Fault exposure detection is switched on as a default for AEC and TDC. If in the initial phase of an exposure too little dose is measured, the exposure is aborted to protect the patient.

- Time of control measurement: 10% of backup time, min. 250 ms at TDC
- Dose minimum: 4% of set density voltage at AEC, 4...10% at TDC
- Backup time AEC: Calculated time from 10 times mAs of the respective 2-factor technique. Max. 4s.
- Backup time TDC: Exposure time set 0.3...6 s

This additional precaution can be switched off for both techniques individually in the menu *”Program/ Dose Rate Control/ Fault Exposure Detection/* ***AEC*** *or* ***TDC****”.*
For details see Fault Finding, OPTIMUS AEC switch-off philosophy and 3Z-XX.

This monitoring does not take effect in the following cases, irrespective of programming:

- Using film/screen combinations with high speed in AEC technique.
- Exposure time in TDC technique is shorter than 1 s.

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9.4.5. CONT

Factors for continuous fluoroscopy can be modified (see also Section ”Fault Finding Explanation of programming) :

- scantime TV [ms] : = 20.00 ms (default) for scantime of the TV system = < 20 ms
  = Scan time of the TV system for scantime > 20 ms
- scantime TV valid : = yes (default)
  = (no) not possible at the moment
- P_max_EDL [W] : 250 W (default) (EDL = Entrance Dose Limiter)
  (range = 0 ... 9000) The maximum output of the tube during continuous fluoroscopy and with the SID signal prevailing is limited to the programmed wattage.
  P_max_EDL [W] is only active if the DRLM (Dose Rate Limiter) signal on 1 WB X12:1 is active (see also Z1-15.2)
  For adjustment see section ”Adjust”.
- TV_pos_limit [V] : 6.8 (default) Adjustment necessary if the fluoroscopic image does not come up properly.
  (range = +3 ... +7.5 V) See section ”Adjustments”.
- TV_neg_limit [V] : -6.8 (default)
  (range = -7.5 ... -3 V)

9.5. Registration devices

- Select menu *”Program/ Registration devices/ RGDV 1...8/* ***Data Set A...B”***.
- Program the data set A and B of RGDV 1.....8 for all exam./aux. units desired.

Data set A:

Room: Room number of the exam./aux. unit for room decade (radiation warning display and door contact).

Tube: Tube assignment for the exam./aux. unit.

Release circuit number: Number of the release decade of the release circuit adaptation unit programmed (e.g.: 1 for X1 etc., see Z1-1.2).

Enable handswitch at generator desk:

Programming	Release switch at generator desk enable	Extern release switch enable [1]
No		X
Yes	X	
	X	X

[1] for this function the WA/WB option is required.

In case an RGDV with bucky controller or THORAVISION is concerned, release is possible only via the release switch at the control desk of the generator. Therefore ”Yes” must be programmed on this RGDV.

Syncmaster present:
No = Free cassette (without cassette present interlock)
Yes = Bucky or tomo synchronous contact (20/21) (WA/WB X1...4:1-2) [2].

Exposure switch type
Single step = Exposure request instantly with preperation.
Double step = Individual preperation request and exposure request.

Bucky format density correction: Density correction in steps of 6%. Range: -8 ... +8
Correction during collimation, input at WAX11/12 pin 1-2 or WBX11 pin 1-2, sidefields active when contact closed (<24x24cm), centre field only when open with GALILEO collimator via Bucky Controller.

[2] All RGDV Bucky TH with Bucky Controller and THORAVISION.

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Data set A continued:

Cone density correction:	Density correction in steps of 6%. Range: -8 ... +8. Input WBX13:4-5 Valid only when the assigned cone contact is closed.		
Dose measurement input:	Measuring chamber respectively at input EZX 21,22,31,32,41		
	none	=	No measuring chamber assigned. For free cassette or tomography without TDC.
Dose measurement sensor type			
Bucky amplimat:	Input via EZX21/22/31/32/41, measuring field selection on control desk possible.		
Scopo amplimat:	Input via EZX21/22/31/32/41, only centre field displayed on the control desk has to be programmed in case of a "Junior Diagnost" or "Extremeties" measuring chamber to prevent from sidefield selection.		
Photo sensor:	Input via EZX61, if "none" has been programmed at "Dose measurement input", in this case the exposure start command has to be connected to the central part via signal bus.		
Photo sensor/amplimat input:	Photo sensor input via EZX21/22/31/32/41. EZX41prefered for DSI to get exposure series with non-AEC techniques, only possible with EZX41		
Exposure series/Tomo movement:	No	=	Instant brake after exposure end.
	Yes	=	- More than one exposure possible with one PREP has to be "yes" - For tomography (preparation must be active until the tomo stand is back to the start position). - Any tomo in combination with a "Release decade adaptation unit" 1WA/2WA in case of "Bucky TH with TOMO via Bucky Controller". - DSI or multiple exposures in SCOPO.
Release delay (automatic techniques):	enable	=	[1] Must be enabled for all automatic techniques
	disable	=	automatically disabled if non AECtechniques selected, leave Release delay always on enable
Mounted radiographical controller:	none	=	No CAN controlled examination unit is assigned to this RGDV.
Bucky controller 1...2		=	CAN controlled bucky unit 1 or 2 is assigned to this RGDV.
Thorav. / Dig. Bucky		=	THORAVISION system or Digital Bucky are assigned to the RGDV
Release circuit adaptation unit:	Assignment of the release unit 1WA, 2WA,1WB.		
	none	=	free cassette or in case of a CAN driven examination unit
Mounted tomo extension:	none	=	no tomo unit installed
	1WA	=	(1)WAX21 valid as tomography time input.
	2WA	=	2WAX21 valid as tomography time input.
Medium II format kV corr. (dose equiv. steps):	Range = 0...8 dose equiv. + kV correction steps		
Medium II format density corr. (-6% steps):	Range = 0...8 -6% density steps		
Medium II format mAs corr. (-6% steps):	Range = 0...8 -6% mAs steps		
Small II format kV corr. (dose equiv. steps):	Range = 0...8 dose equiv. kV reduction steps		
Small II format density corr. (-6% steps):	Range = 0...8 -6% density steps		
Small II format mAs corr. (-6% steps):	Range = 0...8 -6% mAs steps		

Bucky Controller 1 may only be programmed for RGDV 1...4 and Bucky Controller 2 may only be programmed for RGDV 5...8.

An RGDV must not be assigned to a "Mounted radiographical controller" and a "Release circuit adaptation unit" together.

[1] (enable = automatically off in manual techniques)

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Data Set B:

Used for tomo:	No	
	Yes =	With "Yes" a definition of the tomography time is expected from the ex amination unit, e.g. via WAX21 or from a Bucky controller with Tomo.
Used for fluoroscopy:	No =	Ok
	Yes =	Only possible in combination with "Release decade adaptation unit WB" and if programmed in generator function key EZ139 D38 and generator base prepared for fluoro.
CT add on:	No	
	Yes =	For therapy simulator purpose, allows run times ≥16 seconds in continuous fluoroscopy mode.
Disable time override:	No	
	Yes =	With "Yes" time correction via ± buttons on the desk disabled. Automatically disabled with "Used for tomo = Yes".
Tube power factor:		1 ... 100%
kV steps:		Single = kV-grading in steps of 1 kV.
		Dose equivalent = 6% kV steps ≙ 25% density steps.
mAs steps:		step width in 25, 12 or 6%.
mA steps:		step width in 25, 12 or 6%.
time steps:		exposure time step width in 25, 12 or 6%.
Density steps:		step width in 25, 12 or 6%.
Density correction (6% steps):		-8 ... 0 ... +8 correction steps. For correction see chapter 13.
Underexposure display (non-automatic techniques):	Yes =	Underexposure is also indicated with techniques without AMPLIMAT.
	No =	must be set for tomo.
Tube overload protection:	On =	Overload protection active (default): red = no PREP possible
	Off =	Exposures are possible irrespective of load status.

desk display	tube load
green	100 %
green – yellow	100 %
yellow	80 %
yellow – red	64 %
red	0 %

- Select menu *"Program/ Registration Devices/ RGDV Interface Assignment/* ***Bucky/Tomo 1WA...2WA***".
  There must be no programming here if the diagnostic unit is connected via the CAN interface.
- Assign the format and ready contacts of the decade connector WAX11 or WAX12 to a bucky or tomography RGDV. Refer to Z1-15.1.
  - Decade Bucky 1 (X11) See following table.
  - Decade Bucky 2 (X12) Program the functions as for the first Bucky decade.
  - Tomo Time 0.1 ... 6000 ms for each trajectory.

One tomography unit can be programmed for each device interface.

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Decade Bucky 1 ... 2

Tomo mode switch:	disable =	Input ”tomo mode” is not activated. Changeover Bucky/tomography not possible via the examination unit.
	enable =	Input ”tomo mode” is activated. Remote changeover Bucky/tomography possible. Bucky and tomo RGDV must be defined.
Bucky RGDV – switch related:	none/ RGDV 1...8	
	The inputs ”format contacts” and ”bucky ready” are activated.	
	When the tomo mode switch is enabled, this RGDV is activated when the tomo mode switch is open.	
Bucky RGDV:	none/RGDV 1...8	
	The inputs ”format contacts” and ”bucky ready” can be assigned to another RGDV button.	
Tomo RGDV – switch related:	none/ RGDV 1...8	
	The inputs ”format contacts” and ”tomo ready” are activated. When the tomo mode switch is enabled, this RGDV is activated when the tomo mode switch is closed.	

- Select ”Program / Registration Devices / RGDV Interface Assignment / Bucky / Scopomat 1WB”.
  - Bucky RGDV: none or
    RGDV 1...8 activates inputs at WBX 11 for RGDV:
    - X11 : 9 – 10 R/F Controller ready-closed.
    - X11 : 1 – 2 Format size correction contact (Bucky chambers only).
- Reset the generator.
- Note the program settings in 2Z–2.0.

9.6. Example for RGDV programming (see 2Z–2.x)

9.6.1. Example 1: DIAGNOST 76 (D76) and bucky wall stand / free cassette

Use only adapter WB.

RGDV 1: D76: Exposure on Scopomat and fluoroscopy
- Release circuit at 1WB X1
- Measuring chamber at EZX21
- Ready and format contacts via 1WB X11

RGDV 2: D76: Exposure on DSI and fluoroscopy
- Release circuit at 1WB X2
- Photosensor output at **EZX41**: Important! Only this measuring-chamber input sends signal REL (release) which is needed for DSI with non–automatic techniques!
- Ready and format contacts via 1WB X11

RGDV 3: Bucky wall stand without fluoroscopy
- Release circuit at 1WB X3
- Measuring chamber at EZX31
- Ready and format contacts via 1WB X11

RGDV 4[5]: Free cassette [USA]
- [Release circuit at 1WB X4 for free exposure interlock]

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9.6.2. Example 2: Bucky DIAGNOST TH via CAN interface + DIAGNOST 76 (D76)

1. Examination units: - Bucky DIAGNOST TH with wall stand VE or VT
   - with sensing and/or tomography (= with bucky controller)
2. Examination units: - DIAGNOST 76
   - Exposure and fluoroscopy on Scopomat / DSI

Bucky DIAGNOST TH:

RGDV 1: Bucky
- Measuring chamber at EZX21

RGDV 2: Tomography

RGDV 3: Bucky wall stand
- Measuring chamber at EZX31

RGDV 4: Free cassette

DIAGNOST 76:

RGDV 5: D76: Exposure on Scopomat and fluoroscopy
- Release circuit at 1WB X1
- Measuring chamber at EZX22
- Ready and format contacts via 1WB X11

RGDV 6: D76: Exposure on DSI and fluoroscopy
- Release circuit at 1WB X2
- Photosensor / amplimat input at **EZX41**: Important! Only this measuring-chamber input sends signal REL (release) which is needed for DSI with non–automatic techniques!
- Ready and format contacts via 1WB X11

9.6.3. Example 3: DIAGNOST 96 (D96) und bucky wall stand / free cassette

RGDV 1: D96: Exposure on cassette and fluoroscopy
- Release circuit at 1WB X1
- Measuring chamber at EZX21
- Ready and format contacts via 1WB X11

RGDV 2: D96: Tomography cassette and fluoroscopy
- Release circuit at 1WB X2
- Dose measuring input: none
- Ready and format contacts via 1WB X11

RGDV 3: D96: Exposure on DSI and fluoroscopy
- Release circuit at 1WB X3
- Photosensor / amplimat input at **EZX41**: Important! Only this measuring-chamber input sends signal REL (release) which is needed for DSI non–automatic techniques!
- Ready and format contacts via 1WB X11

RGDV 4: D96: Tomography DSI and fluoroscopy
- Release circuit at 1WB X4
- Dose measuring input: none
- Ready and format contacts via 1WB X11

RGDV 5: Free cassette
- Release circuit at 1WA X1

RGDV 6: Bucky wall stand
- Release circuit at 1WA X2
- Measuring chamber at EZX31
- Ready and format contacts via 1WB X11

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9.6.4. Example 4: Unit connected via adapter WA

Examination unit:
- HDH without / with tomo time input (unit UP)
- Tomo programs: 1= 30°, 0.8 s (UP 6/7:01)
  2= 30°, 3.2 s (UP 6/7:02)
  3= 8°, 0.8 s (UP 6/7:03)
  4= 8°, 3.2 s (UP 6/7:04)
- Connection via Adapter for 4 Aux. Units WA
- Ready and format contacts connected at WAX11.
- 1 tube

RGDV 1 =	Bucky	Release circuit 1 at WAX1, Measuring chamber at EZX21
RGDV 2 =	Tomography	Release circuit 2 at WAX2; Measuring chamber at EZX21 for TDC
RGDV 3 =	Bucky wall stand	Release circuit 3 at WAX3, Measuring chamber at EZX31
RGDV 4 =	Free cassette	- -
	/Free cassette USA	Release circuit 4 at WAX4 for free exposure interlock

Programmings in ( ) relate to the option ”Automatic tomographic time input” via assembly UP of HDH.

Programmings in [ ] relate to the option ”Tomo Density Control”.

Programmings after a stroke relate to the option ”Free Exposure Interlock”, which is necessary in some countries such as the USA.

9.6.5. Example 5: Unit connected via CAN interface

Examination unit:
- Bucky DIAGNOST TH with wall stand VE or VT
- with sensing and/or tomography (= with Bucky controller)
- 1 tube

RGDV 1 =	Bucky	Measuring chamber at EZX21
RGDV 2 =	Tomography	Measuring chamber at EZX21 for TDC
RGDV 3 =	Bucky wall stand	Measuring chamber at EZX31
RGDV 4 =	Free cassette	

Programmings in [ ] relate to the option ”Tomo Density Control”.

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10. Tube adjustment

Warning!
Radiation is released during the adjustment procedure!

The generator must be in the READY state, i.e. the green ring at the desk must be illuminated!

10.1. Tube conditioning

This procedure must be performed for each new tube to be connected up, irrespective of the storage time. The interval times between exposures must be adhered to and monitored with a watch. For tubes with a maximum of 125 kV the last two break-in stages must be at 109 kV and 125 kV. The break-in of the tube only takes place on large focus.

- Perform the following programmings temporarily:

  For each tube connected in one of the assigned RGDVs (free cassette recommended) in the menu *"Program/ Registration devices/ RGDV #/**Data Set A**"*:

  - Enable handswitch set generator desk: Yes
  - Syncmaster present: No
  - Exposure switch type: Double Step
  - Exposure series / Tomo movement: **yes**
  - Mounted radiographical controller: none

- Reset generator.
- Select appropriately programmed auxiliary for the respective tube to be break in.
- Select large focus.
- Release exposures according to the following table.

  The exposure run must always be made at one kV level without any repeated start-up of the tube, i.e. the PREP button must always remain pressed during the run.

Number of EXPs	kV	mAs	Pause [s]
5	81	125	1
			30
3	102	125	1
			30
2	117 (109)	125	1
			60
2	141 (125)	125	1
			120

  In the event of electrical interference the process must be continued after an interval of 5 minutes, starting at the lower kV level.

- Set RGDV programming to the original status.
- Reset generator.

After operating intervals at the customer's of over 3 months it is recommended that 5 exposures be made on the large focus at 81 kV and 125 mAs. Between exposures there should be intervals of 15 s.

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10.2. Adaptation of the tube

Adaptation is an automatic process which has to be performed for each focus of all the tubes connected.

Boost Adaptation, where the inertia of the filament with respect to heating up and cooling down is registered, is integrated into this process.

In case an error message occurs during the adaptation procedure, reset the generator and repeat the adaptation for this particular focus.

- Check whether the upper kV limit for data adaptation in the menu *"Program/ Tubes/* ***Tube Limits****"* is programmed according to the tube connected.

  If older tubes are to be operated on this generator, it is urgently recommended that the maximum kV used in practical operation so far be specified instead of the theoretical possible value.

- Select menu *"Adjust/* ***Tube Adaptation****".*

- Select the tube to be adapted and the focus to be adapted.
  Start with the small focus!

  Caution!
  To avoid any errors make sure that "READY" is displayed on the desk before pressing button F2.

- Press button F2.

  - "Adap" is displayed on the desk.
  - "Waiting" is displayed on the screen.

- Wait until the generator is in the READY state.

- Start the adaptation procedure by pressing the handswitch continuously.

  The generator carries out adaptation of the focus automatically. It may happen that the red LED on the desk lights up for a short time.

  The tube adaptation of the focus is complete when "Adap" has disappeared on the desk and "Test" is displayed.

- Let go of the handswitch.

- Reset the generator.

- Repeat the adaptation procedure for each additional focus and tube.

  As there is no tube with a middle focus get, it can not be adapted.
  Vario Focus is available, if small and large focus are adapted, it is a calculated combination of small and large.

- When the tube has been adapted "Function Unit kV" (EZ 130) must be re-aligned. For alignment work refer to section "Adjustments".

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11. Application Limits

11.1. X-Mode-Limits

Using the menu *"Program/ Application Limits/* ***X-Mode Limits****"* all the types of generator technique available can be varied in the following parameters:

- Min./Max. Time Limit
- Min./Max. Current Time Product Limit

A modification is usually only necessary if specific national legislation defines different limits.

11.2. THORAVISION Limits

The kV-dependent mAs limits can be accessed via the menu *"Program/ Application Limits/* ***THORAVISION Limits****"*. They are activated only in conjunction with an on-line THORAVISION unit.
A change may only be made if instructed to do so by the service centre.

Reference files on floppy disk: - ref_limx.tdl X-ray limits
- ref_limt.tdl THORAVISION limits

11.3. Overload-dependent Limits (for continuous fluoroscopy)

- max. current for continuous fluro [mA]: Range = 3...30mA
- max current during overload for continuous fluro [mA]: Range = 1...3mA.

12. Programming the operating desk

A maximum of up to 1024 APRs can be stored in the generator.

On a single RGDV button either up to 80 APRs can be programmed directly (10 pages of 8 each) or up to 400 APRs via menus.

The initial data sets are called ### APR name ### and they have the same exposure parameters.

They can be directly assigned or via menu and submenu levels to registration devices RGDV 1...8.

In case "Test APR" is displayed after selection of a registration device, at least this particular registration device has not been assigned to any APRs.

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12.1. Additional program settings for generators without option APR/F (anatomically-programmed radiography/fluoroscopy)

In case a generator without option APR/F 9890 000 0282x is present, the menu/APR display field must be dark upon selection of all exam./aux. units.

If this is not the case “Empty-APR/T” must be loaded from the service disk for each exam./aux. unit.

In case

”Test APR”

appears in the menu/APR display field upon selection of the exam./aux. units, the “Empty-APR/T” can be loaded immediately because no APR/T is assigned to the exam./aux. unit.

In case another APR/T or menu appears on the desk it must be deleted before the “Empty-APR/T” can be loaded:

- Delete the APR/T under each exam./aux. unit:

  ”Program/Human interface/RGDV related assignment/RGDV 1 .... 8/Manual assignment/***Delete menu***”.

After a reset of the generator “Test APR” appears in the menu/APR display field for each exam./aux. unit.

Now the “Empty APR/T” can be loaded from the service disk for all exam./aux. units:

- Load ”Empty-APR/T” for all exam./aux. units:

  ”Program/Human interface/RGDV related assignment/RGDV 1 .... 8/Predefined Assignments”.

A list of possible TDL-files appears on the screen.

- Select file ”AR_EMPTY.TDL” from the list.

Only: ”none APR” appears.

- Select it for each active exam./aux. unit.

After a reset of the generator the menu/APR display field is dark for all exam./aux. units.

12.2. Language

The language for operating instructions is selected in this menu.

- Select menu ”*Program/ Human interface/* ***Select Language****”*.
- Select the desired language:
  - English
  - German
  - French
  - Spanish
- Reset the generator.

For table lists which characters can be displayed on the control desk and how they can be indicated/entered at the service PC, e.g. for APR names, see 2Z-3.1 + 3.2 List of characters.

Certain characters can be generated at the PC only via the decimal code. To do so, press the ”Alt” key on the PC and enter the numerical code.

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12.3. Automatic programming of APRs (option)

The installation disk contains data files for a complete, typical APR programming in different languages.

Standard APR programs for each application can easily and quickly be loaded for each registration device.

Note
During this procedure the CAN interface on EZX43 must be disconnected if present (THORAVISION or Bucky TH with bucky controller).

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/* ***Predefined assignment****"*.
- Select with TAB and cursor-down key one of the files listed up, e.g. "ar65eng.tdl".

  Meaning:
  - a = APR data file
  - r = radiography
  - 65 = version (month/year)
  - m = mono focus tube
  - p = pediatrics
  - v = with VARIOFOCUS settings for RO 1750, SRO 2550, SRO 33 100
  - v9 = with VARIOFOCUS settings for SRO 0950
  - eng = language; en(g) = English, de(u) = German, es(p) = Spanish, fr(a) = French

- Select one of the applications listed up, e.g. "Bucky", and load the data file.

  Applications:
  - Bucky — bucky
  - Wallstd — bucky at wallstand
  - Free — free cassette
  - Tomo LT/HDH — linear tomography with units HDH, BTS2, BTS4 (group)
  - Tomo LIN — linear tomography with units HDH, BTS2, BTS4 (paging)
  - Tomo BTC — tomography with unit Bucky DIAGNOST TC
  - Tomo BTH — tomography with unit Bucky DIAGNOST TH

  Extension GR = Group; APRs are divided into groups (menu technique),
  Extension PA = Paging; APRs are assigned directly to an application.

- Repeat this procedure for each registration device.
- Reset the generator.

  Now all APR programs which have been loaded are displayed on the desk.

If required:
- Change the name and the contents of the APRs according to 12.4.
- Change the menus and the assignment of the APRs according to 12.3.

Note
In case a complete APR program setting is to be replaced by another program setting, all other APR program settings under the registration device concerned must be deleted first.

For deleting a program setting call menu "Program/Human interface/RGDV related assignment/RGDV 1...8/Manual assignment/ ***Delete menu****" and select the blank line.*

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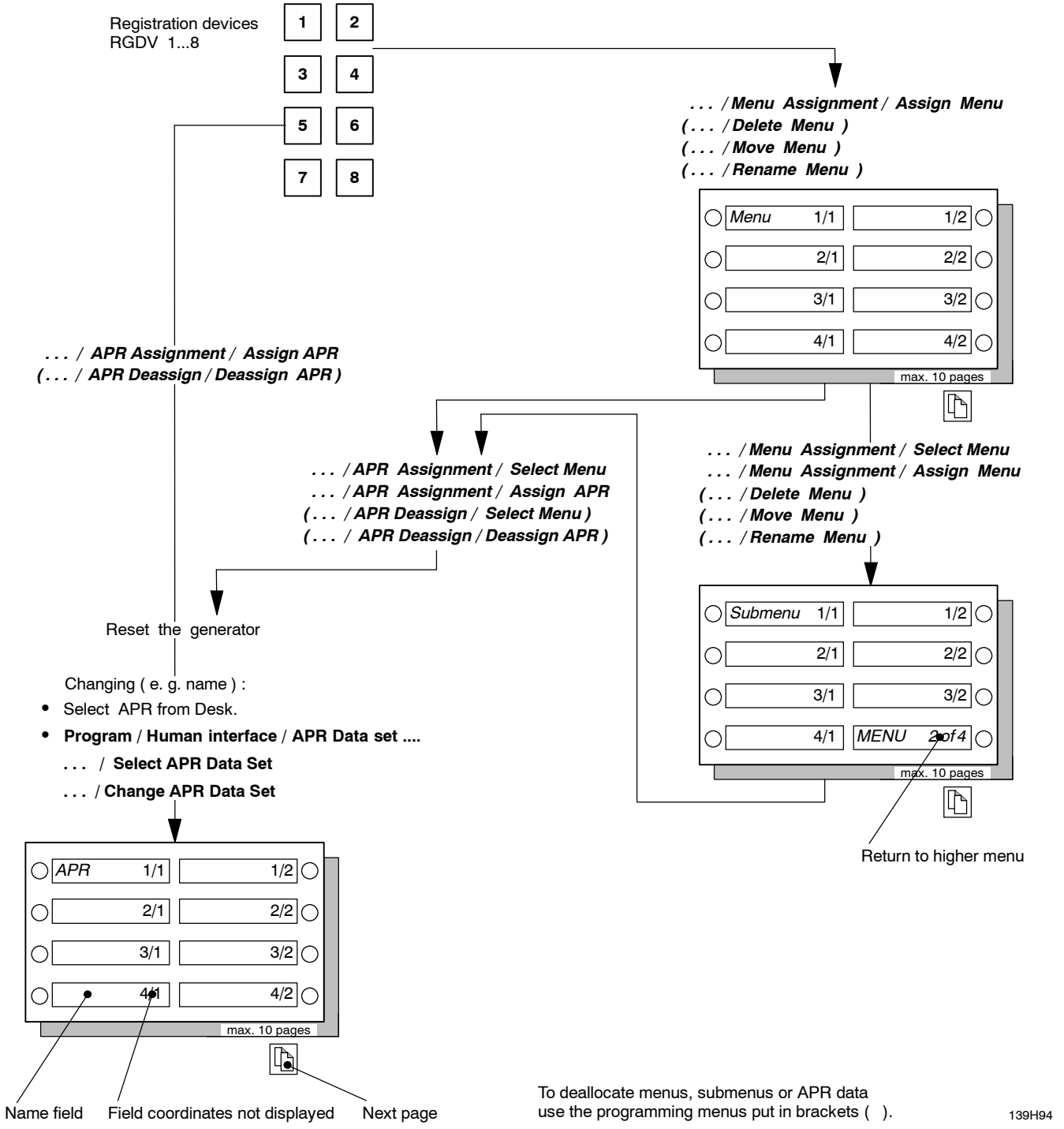
12.4. Manual programming of APRs (option)

Manual APR and menu assignment possibilities

- Select service menu ***Program/ Human interface/ RGDV Related Assignment/ RGDV 1...8 /Manual Assignment ...***



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12.4.1. Creating menus

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ Menu assignment/* ***Assign menu***".
- Enter the first menu name, e.g. "Body region 1".
- If required, change the location suggested in the display. Otherwise the next vacant location is assigned.
- Enter the second menu name, e.g. "Body region 2".

Etc.

12.4.2. Creating sub menus

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ Menu assignment/* ***Select menu***".
- Select with the cursor from one of the windows a menu to be assigned with submenus.
- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ Menu assignment/* ***Assign menu***".
- Enter the first submenu name, e.g. "Left side".
- If required, change the location suggested in the display. Otherwise the next vacant location is assigned.
- Enter the second submenu name, e.g. "Right side".

Etc.

12.4.3. Creating or assigning APRs

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ APR assignment/* ***Select menu***".
- Select with the cursor from one of the windows a menu or submenu.
  If no menu layer is desired, proceed to assign APR.
- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ APR assignment/* ***Assign APR***".
- Select from one of the windows an initial APR or an APR which has not been assigned.
  Initial APR: "### APR name ###
  Not assigned APR: e.g. "Thorax ap"
- If required, change the location suggested in the display. Otherwise the next vacant location is assigned.
- Assign the next APR.

Etc.

- Reset the generator.

Only after a reset of the generator the menus, submenus and APRs are displayed on the desk.

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12.5. Changing of APRs

- Select the APR to be changed on the desk, e.g. ### APR name ###.
- Select menu *"Program/ Human interface/ APR data set/* ***Select APR data se****t"*.
  The number of the APR selected on the desk is displayed. Transmit data with <F2>.
- Select menu *"Program/ Human interface/ APR data set/* ***Change APR data set****"*.
- Change the contents of the APR, e.g. name, kV etc.
  It is recommended that you select the kV value according to the dose-equivalent series:
  40-41-42-44-46-48-50- 52-55-57-60-63-66-70-73-77-81-85-90-96-102-109-117-125-133-141-150 kV.

APR number:		1 ... 1024
APR name:		up to 16 characters
Focus:	*	small/ middle / vario/ large
Vario focus ratio [%]:		20%, 35%, 50%, 65%, 80% of small focus
Dose measurement field (left)	*	on/ off
Dose measurement field (middle)	*	on/ off
Dose measurement field (right)	*	on/ off
Preferred technique:		Non automatic/automatic
AEC technique:		AEC falling load kV/ AEC fixed current kV-mA/ TDC (Tomo Density Control)
No AEC technique:		kV-mA-ms/ kV-mAs/ kV-mAs-ms
Tube current max. factor [%]:		1 ... 100
PSC U thin (dose equiv. steps):		0 ... 5
PSC U thick (dose equiv. steps):		0 ... 5
PSC Q thin (6% steps):		0 ... 10
PSC Q thick (6% steps):		0 ... 10
PSC dens. thin (6% steps):		0 ... 10
PSC dens. thick (6% steps):		0 ... 10
Exposure data U [kV]:	*	40 ... 150
Exposure data I [mA]:	*	0.1 ... 2000
Exposure data Q [mAs]:	*	0.5 ... 850
Exposure time [ms]:	*	1 ... 16000 (60000)
Exposure data density (6% steps):	*	-16 ... +16
Film screen comb.:	*	RGDV-dependent; Default = Data Set 1
Tomo No.:		1 ... 16 assignment of a tomographic figure
Spectral Filter:		none/ 2mm Al/ 0.1mm Cu + 1mm Al / 0.2mm Cu + 1mm Al; Default = none
Fluoroscopy curve:		1-20 default curve 1 Select kV/mA = curve 1, 2 or 3. Curve 1: 70 kV --> 1.7 mA 110 kV 6 mA Curve 2: 70 kV --> 0.8 mA 110 kV 6 mA Curve 3: 70 kV --> 1.2 mA 110 kV 3 mA loaded from the disk Details see section Fault Finding "kV/mA curves Fluoroscopy"

***** = The basic setting of this data can also be performed from the desk ("Reset" + APR). Refer to the operator's manual.

AEC = Automatic Exposure Control

The following parameters must also be taken into account for AEC techniques:

- mAs: basis for calculating the backup time for AEC, the tube current for AEC fixed current (kV-mA) and the initial mA value for TDC
- t: exposure time for TDC and AEC fixed current

For details see chapters 15 and 16.

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If ”AEC fixed current kV-mA” or ”TDC” is programmed as the preferred technique, the kV-mAs-s-technique must be selected under ”No AEC technique”.

- Transmit data with <F2>.
- Select the next APR on the desk, select it in the programming menu and change it.

Etc.

- Reset the generator.

12.6. Moving/copying of an APR data set

Determination of the number of APR data set ”x” to where APR data set ”y” is to be moved/copied.

- Select APR data set ”x” on the desk.
- Select menu *”Program/ Human interface/ APR Data Set/* ***Select APR Data Set****”.*
- Note the number of APR data set ”x”, for instance, 100.

Changing of the number of APR data set ”y” to be moved/copied to the number of APR data set ”x”

- Select APR data set ”y” on the desk.
- Select menu *”Program/ Human interface/ APR Data Set/* ***Select APR Data Set****”*.
  Transmit with F2.
- Select menu ”*Program/ Human interface/ APR Data Set/* ***Change APR Data Set****”.*
- Replace the number of APR data set ”y” with the number of APR data set ”x” in the input mask, for instance, nnn 100.
- Transmit this number with F2 and reset the generator.

APR data set ”y” is displayed in place of the old APR data set ”x” on the desk.
In case APR data set ”y” is merely moved and not copied to the location of APR data set ”x”, the original APR data set ”y” must be deleted at the end of programming.

12.7. Deleting of APRs

- Select menu *”Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ APR deassign/* ***Select menu****”*.
  Required only when the APR is assigned to a menu or submenu.
- Select the associated menu or submenu from one of the windows.
- Select menu *”Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ APR deassign/* ***Deassign APR****”*.
- Select the APR to be deleted from one of the windows.
- Reset the generator.

An APR which has been deleted is no longer displayed on the desk but remains stored in the generator. It can be re-activated according to 12.3.3..

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12.8. Manipulating menus

Deleting:

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/* ***Delete menu***".
- Select the menu or submenu to be deleted from one of the windows.
  For deleting all APR of a RGDV program select the blank line.
- Reset the generator.

Shifting:

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/* ***Move menu***".
- Select the menu or submenu from one of the windows.
- Enter the new positions.
- Reset the generator.

Re-naming:

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/* ***Rename menu***".
- Select the menu or submenu from one of the windows.
- Enter the name in the lowermost line.
- Reset the generator.

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12.9. External APR assignment

A maximum of 3 external APRT modules can be connected to the OPTIMUS R/F via “adapter 4 auxiliary units ” 1WA, 2WA and WB. Also see Z1-15 .

- Define the external APRT modules by placing links W1 through W3 on adapters WA/WB.

  Also see table ”Assignment of the external APRT modules” below and Z1-15.xx ”Adapter 4 auxiliary units”.

- If necessary, program the desired APRT in the generator.

- Select the desired APRT number for the external APRT modules from the RGDVs:

  ”Program / Human Interface / APR Data Set / ***Select APR Data Set*** ”.

- Program the RGDVs that are to be switched over by the external APRT modules:

  ”Program / Human Interface / RGDV related Assignments / RGDV 1 ... 8 / External APR Assignments /

  - ***device interface 1*** ”

or

  - ***device interface 3*** ” .

Only two RGDVs can be programmed and respectively, switched over. Once programmed, these two RGDVs are valid irrespective of the selected APRs of the other buttons of the module.

- Program the APRs that are to be selected by the external APRT modules:

  ”Program / Human Interface / RGDV related Assignments / RGDV 1 ... 8 / External APR Assignments /

  - ***device interface 1*** ” : 6 APR keys can be assigned for each RGDV

and/or

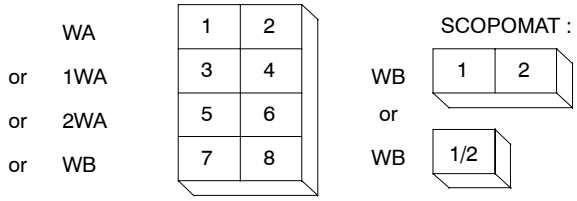
  - ***device interface 2*** ” : 8 APR keys can be assigned for each RGDV

and/or

  - ***device interface 3*** ” : 8 APR keys can be assigned for each RGDV.

- Enter the RGDVs and APRs programmed in table 2Z-5 ”Programming of device interfaces”.

- Device interface 1
- Device interface 2
- Device interface 3 .



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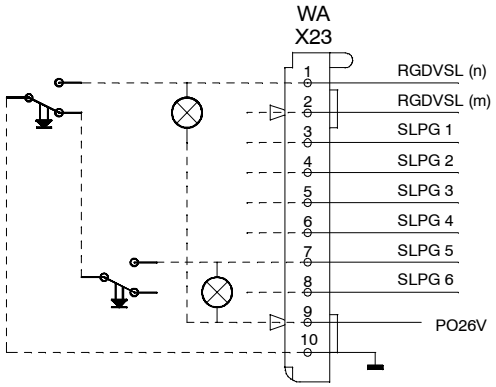
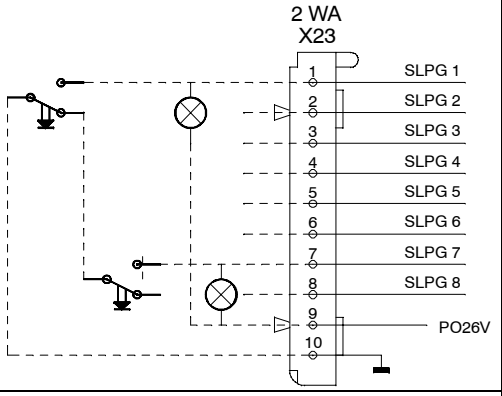
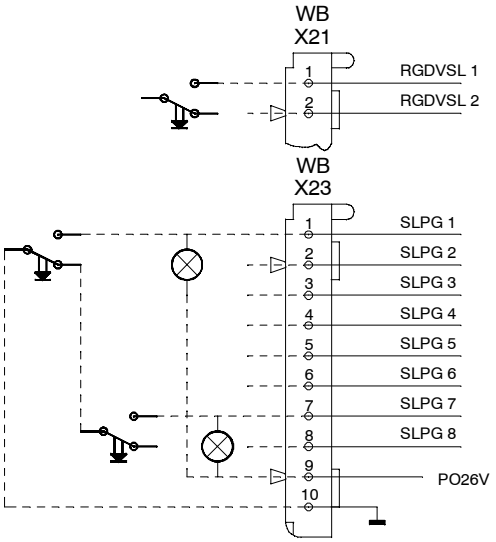
Assignment of the external APRTs:

Device interface	Adapter	Programming W1/W2/W3	Hardware connection	Remark
1	WA or 1 WA	W1-W3 open		2 selectable RGDVs can be programmed. They are independent of the APRs programmed. Maximum number of APRs: 6 x 8 (RGDV) = 48 APRs Recommendation: 2 APRs assigned to each button
2	2 WA	only W1 closed		RGDV cannot be selected. Maximum number of APRs: 8 x 8 (RGDV) = 64 APRs Recommendation: 2 APRs assigned to each button Operation as 2 WA is possible also without 1 WA. Also see drawing Z2-15.x Cabinet wiring: Decade adapter WA / WB
3	WB	only W2 closed		2 selectable RGDVs can be programmed. They are independent of the APRs programmed. Maximum number of APRs: 8 x 8 (RGDV) = 64 APRs Recommendation: 2 APRs assigned to each button

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13. Density correction

13.1. Density correction for AEC technique (option)

Basic density per film/screen combination:

A hardware key is required at the PC for direct access to the switch-off dose.

- Make a test exposure for each film/screen combination.
  To do so, select APRs with density correction ”0”.
- Determine density of the test exposures.
- Select menu *”Program/ Dose rate control/ AMPLIMAT/ Chamber 1...5 /* ***Data set 1...5****”*.
- Select manual DRC programming with <Escape>.
- Correct the switch-off dose FSC according to formular below:

$$\text{New switch-off dose} = \frac{\text{Desired density}}{\text{Measured density}} \times \text{Old switch-off dose}$$

- Transmit the data set with F2.
- Repeat the procedure for each film/screen combination.
- Reset the generator.

The switch-off dose can be set on the PC even without a hardware key.
To do so, call up the automatic DRC programming, repeat all the selections and change the correction factor for switch-off dose accordingly. Each time this programming is called up all the selections must be repeated.

Organ-dependent correction:

- Select the APR to be changed on the desk.
- Select menu *”Program/ Human interface/ APR data set/* ***Select APR data set****”*.
  Confirm the APR number displayed with <Transmit>.
- Select menu *”Program/ Human interface/ APR data set/* ***Change APR data set****”*.
- Exposure data density: −16 ... +16 = correction in steps of 6%.

  The number of correction steps must match to the programmed step rate.
  Example:
  The desk display has been programmed to the R20 series (=12%) in the menu *”Program/ Registration devices/ RGDV 1...8/ Data Set B/* ***Density steps****”*. To be able to display a density correction of +1 for a certain APR two corrections steps (2x6% = 12%) must be programmed under this APR.
- Select the next APR on the desk, select it in the programming menu and change it.

Etc.

- Reset the generator.

Correction for each RGDV 1...8:

This correction is possible but for reasons of clarity it should not be used.

- Select menu *”Program/ Registration Devices/ RGDV 1...8/* ***Data set B****”*.
- Density correction: −8 ... +8 = correction in steps of 6%.

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13.2. Density correction for non-AEC techniques

The supplied APR standard sets are mostly based on a film/screen combination with an intensification of 400.
APR for extremities and some other applications are based on a 100 or 200 type system. Depending on the local situation the ”mAs” or ”s” parameters of all the relevant APRs must be adapted.
Example:
The customer uses a 200 type system. To change from the existing ”400” values the relevant APRs must be reprogrammed to double the mAs products or to double the exposure time (400 divided by 200=2).

- Select the relevant APR at the control desk.
- Set the new parameters at the control desk.
- Save the new parameters as default values. To do this press the ”Reset” button and the corresponding APR button. The asterisk in the APR name as an indication of overwritten data disappears.

14. Interlock facility for APR modification

Using the menu *”Program/ Human interface/* ***APR modifiable by User****”* it is possible to prevent a customer from being able to store APR modifications as default setting via the control desk.

Default: yes

15. AEC fixed current (kV-mA) (option)

For this exposure technique the APRs must have the following programming:

- Dose measurement field: on (at least 1 field must be set to ON)
- Preferred technique: automatic
- AEC technique: AEC fixed current kV-mA
- No AEC technique: kV-mAs-ms technique (RUQT) or kV-mA-ms (RUIT)
- Exposure data U: = anatomical kV value
- Exposure data Q/I: = anatomical mAs/mA product based on the screen-film combination used.
- Exposure time t: = anatomical exposure time.

  The mA value is calculated automatically.

In the APR standard files supplied the following APR is programmed to kV-mA technique
(language: German/English/French/Spanish):

- Dens axis F / dens axis F / dens axis F / atlas F

  The APR is marked with ”F”.

The mAs value is based on a 400-type screen-film combination and must be adapted to the combinations actually used. If, for example, the 200-type combination is used, the mAs value must be doubled.

If the TDC option is installed, the preferable technique for all exposures is the one where the exposure time is the determining factor. TDC is not restricted to tomography applications.

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16. Tomo Density Control TDC (option)

For this exposure technique the APRs must have the following programming:

- Dose measurement field: on (at least 1 field must be set to ON)
- Preferred technique: automatic
- AEC technique: TDC (Tomo Density Control)
- No AEC technique: kV-mAs-ms technique (RUQT) or kV-mA-ms (RUIT)
- Exposure data U: = anatomical kV
- Exposure data Q/I: = anatomical mAs/mA product based on the screen-film combination used.
- Exposure time t: = anatomical exposure time.

The mAs product is used to calculate the start current, indicated under Exposure Data I.
In the APR files supplied all the APRs for tomography applications are programmed to TDC. If there is no TDC option installed, the manual technique will be selected as the Preferred Technique automatically.

TDC is not restricted to tomography applications so it can be preferred for all exposures where exposure time is the determining factor.

The respective mAs product is generally based on a 400-type screen-film combination and must be adapted to the combinations actually used. If, for example, a 200-type combination is used, the mAs product must be doubled.

17. VARIOFOCUS (option)

For the VARIOFOCUS option, special APR files have to be loaded. These are designated with a "v" in the file name and contain correspondingly defined APRs.

VARIOFOCUS is programmed as a percentage mix of the small focus with the large focus. The following steps are possible: 20%, 35%, 50%, 65% and 80% of the small focus. As a rule, the predefined APRs are programmed at 50%.

The percentage mix is not displayed direct on the control desk and can only be estimated indirectly via the small/large focus exposure time.

It is only possible to display and change the percentage mix via XRGSCOPE menu *"Program/ Human interface/ APR Data Set/* ***Change APR Data Set****"*. However, VARIOFOCUS can be selected via the control desk and can also be stored as default focus for an APR. The percentage mix is then always 50%.

VARIOFOCUS is only possible for tubes with superimposed focal spots.

The following tubes are suitable for the application: SRO 0950, SRO 2550, SRO 33100, RO 1750.

18. Area Dose calculator (option)

This option operates only in conjunction with a unit and a collimator which are CAN-controlled and supply information about SID, collimation and added filters.

Check and correction: see ADJUSTMENTS section.

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19. Executing the acceptance test

- Execute the acceptance test according to section *"Acceptance".*
- Observe all applicable national regulations.

For U.S.A.:

Checking H.H.S. requirements

After completition of setting-to-work, the system must be tested for H.H.S. compliance according the P.M.S.I. comprehensive compliance testing workbook (code No. 4535 800 2035.).

20. Saving all configuration data

A hardware key is required for the PC.

To save the configuration data use the "Configuration Backup" disk supplied.

- Save the complete SW programming of the generator using the menu "Accept/ Backup/"on the floppy disk.:

- RGDV related Assignments

RGDV 1...8

APR Assignments After **Reading** (turning bar) the PC offers the default backup name **Backup File Name: APR_BAK1**...8**.TDL**.
The name can be changed into any other file name.
The path (harddisk) will automatically be taken into account. It is also possible to type **A:\filename** <RETURN> to load the backup files directly to the floppy disk.

- CU Complete

The default backup name **Backup File Name: CUBACKUP. TDL** (or A:\filename <RETURN>) can be changed into any other filename. A disk space of 700 kByte is required. It takes about 8 minutes to save the data to the disk.

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21. Labels

- Check the labelling according to the respective generator type.

See drawing 2Z-1.

All lables become visible by swiveling out the label bracket simply by hand and without any tool. The bracket is located at the top left corner of the front side of the cabinet, visibly marked by an ”i” (for information) and text ”Certified Component Lables Here”. If you swivel the label bracket 90 degrees to the right the following labels will appear at its bottom side:

- X-Ray Control:
  - type designation
  - serial No.
  - name and address of manufacturer
  - DHHS certification statement (if necessary)
  - date of manufacture
- X-Ray H.V. Generator:
  - type designation
  - serial No.
  - name and address of manufacturer
  - DHHS certification statement (if necessary)
  - date of manufacture
- Technical Data label with UL/CSA classification (if necessary)

22. Final installation work

- Mount the side panels of the generator cabinet.
- Take care that all cables inside the wall junction box are routed in closed loops loop without any kinks.
  Roll the generator cabinet against the wall.
- Block the two front wheels of the cabinet with the locking screws to guarantee that unauthorized persons cannot accidentally touch parts of the generator which might be dangerous.
- If necessary, level the cabinet with the locking screws.
- Mount the front cover of the generator.

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ADJUSTMENTS

TEXT

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1. Area Dose calculator (option)

Special tools:

- calibrated dosemeter, e.g. DALI with measuring cell 77334 or PMX3
- 1 mm lead plate

The following parameters are relevant to calculation:

- SID (Source Image Distance)
- diaphragm aperture
- added filters
- specific yield of tube
- mAs product
- number of exposures

SID, diaphragm aperture and type of filters are supplied by the diagnostic unit, where they are also adjusted.

In the generator default values are given for the specific yield of a tube and filter correction.

These default values can be found as reference files on floppy disk in order to recreate the original settings if need be.

Reference files:

ref_yiel.tdl	specific yield of tube
ref_2al.tdl	filter 2 mm Al
ref_01cu.tdl	filter 1 mm Al + 0.1 mm Cu
ref_02cu.tdl	filter 1 mm Al + 0.2 mm Cu

The specific yield curve relates to tungsten anodes and 2.5 mm primary filters.

Display on the desk is in: [cGycm^2].

1.1. Checking the default adjustment

- Place the lead plate and the measuring cell of the measuring instrument on the table in the central radiation beam. The purpose of the lead plate is to reduce radiation scatter of the table top. Without the plate the test result would be approximately 10% higher using a table top made, for example, from resin bonded paper.
- Perform the following settings:
  - 1 m between the focus and the measuring cell (=SMD)
  - free cassette technique
  - kV-mAs-s technique
  - 10 mAs
  - 0.1 s
  - collimation 10 x 10 cm at the height of the measuring cell
  - no filter

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- Determine area dose at the following kV settings and compare it with the respective value displayed on the desk.

	50 kV	**80 (81) kV**	**120 (117) kV**
displayed product	..... $cGycm^2$	..... $cGycm^2$	..... $cGycm^2$
measured dose	..... cGy	..... cGy	..... cGy
calculated product	..... $cGycm^2$	..... $cGycm^2$	..... $cGycm^2$
difference in %	.....	.....	.....

Example:

- displayed area exposure product: 8.8 $cGycm^2$
- measured dose: 890 μGy = 0.089 cGy
- calculated area exposure product: measured dose × exposed area
  = 0.089 cGy × 100 cm^2
  = 8.9 $cGycm^2$
- difference in %: $= \frac{8.9-8.8}{8.9} \times 100 = 1.12\ \%$

- If there are any deviations of over 5% it is recommended that the yield curve be corrected in accordance with the procedure described in 1.2.

1.2. Correction of the specific yield

Prerequisite:

Test setup and settings in accordance with section 1.1.:

- 1 m between the focus and the measuring cell (=SMD)
- free cassette technique
- kV-mAs-s technique
- 10 mAs
- 0.1 s
- collimation 10 x 10 cm at the height of the measuring cell
- no filter

Principle:

For each kV specified a dose measurement is taken under the same conditions. If the distance between the focus and the measuring cell deviates from 1 m, all the dose values must be corrected with the square of distance (unit of measurement is [m]). Dividing the dose values by the mAs product set gives the respective current yield.

Procedure:

- Measure dose at each kV checkpoint and use it to calculate specific yield.

  The values determined must be greater at higher kVs settings and produce a characteristic with a slight curve on the graph. If considerable fluctuations are detected, the measurements must be repeated at the points in question.

  Range: 0.00 ... 400.00 μGy/mAs

  The values can only be stored in the generator if they are within the range specified and rise uniformly with kV.

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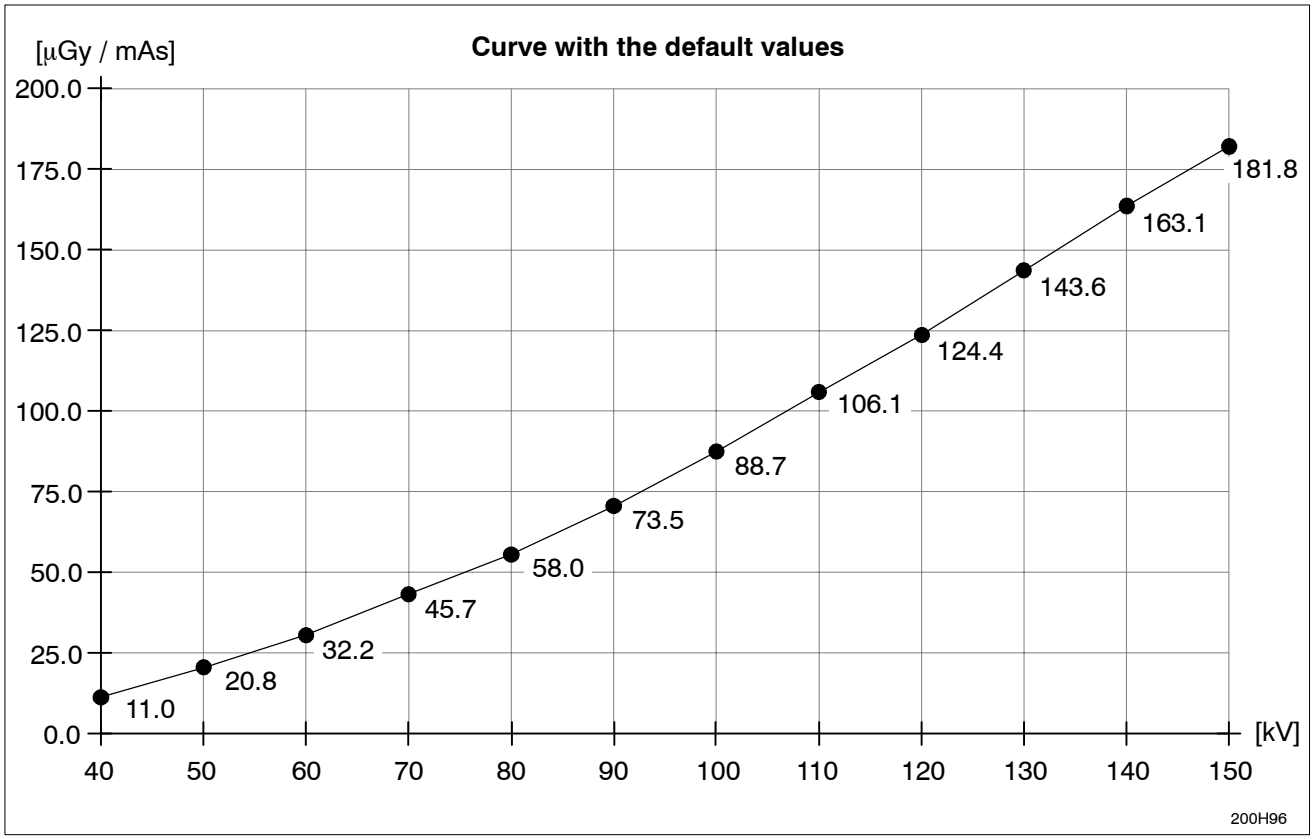
Specific yield

kV checkpoint	40	50	60	70	80	90	100	110	120	130	140	150
default yield [µGy/mAs]	11.0	20.8	32.2	45.7	58.0	73.5	88.7	106.1	124.4	143.6	163.1	181.8
measured dose [µGy]												
distance^{2}factor	If the distance focus – measuring cell (= SMD) differs from 1 m correct the dose with this factor, distance^2 factor = (SMD [m] / 1 m)^2 = ... e.g. = 1.44 for a SMD of 1.2 m											
corrected dose [µGy]												
specific yield [µGy/mAs]	calculate: specific yield = corrected dose / 10 mAs											



- Correct the default values of the specific yield for all the kV checkpoints using the menu ***"Adjust/Area Exposure Product/ Specific Yield of Tube 1...3"*** with the factor determined and save with <Transmit>.
- Save the specific yield curve with the SAVE function of XRGSCOPE (F3 key) on the backup disk.
  Recommended file name: act_yiel.tdl

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1.3. Correction of the filter values

Prerequisite:

Test setup and settings in accordance with section 1.1.

- 1 m between the focus and the measuring cell (=SMD)
- free cassette technique
- kV-mAs-s technique
- 10 mAs
- 0.1 s
- collimation 10 x 10 cm at the height of the measuring cell
- no filter

Principle:

At otherwise identical settings the dose is determined for the kV values specified with and without filter. The ratio of dose values with/without filter produces the respective current correction factor.

Procedure:

- Accept measured dose values (not the corrected ones!) for the respective kV checkpoints from yield measurement or measure them again if any changes have been made to the test-setup or settings.
- Move the filter to be checked into the radiation beam.
- Measure dose at each kV checkpoint and enter it in the respective table.
  Note
  The 40 kV range is not used in practice so it does not have to be corrected.
  If in the lower kV range the considerably reduced dose can no longer be measured or read perfectly, at that point a higher mAs product must be selected. Then the repeat measurement must be performed without filter.
- Using the ratio between dose with and without filter determine the respective correction factor.
  The values determined must be greater at higher kVs settings and produce a characteristic with a slight curve on the graph. If considerable fluctuations are detected, the measurements must be repeated at the points in question.
  Range: 0.000 ... 1.000
  The values can only be stored in the generator if they are within the range specified and rise uniformly with kV.
- Perform the procedure for each selectable filter type.

Filter correction - 2 mm Al

kV-checkpoint	~~40~~	50	70	100	150
default factor	~~0.39~~	0.47	0.56	0.66	0.75
measured dose [µGy] without filter					
measured dose [µGy] with filter					
new factor	new factor = dose with filter / dose without filter				

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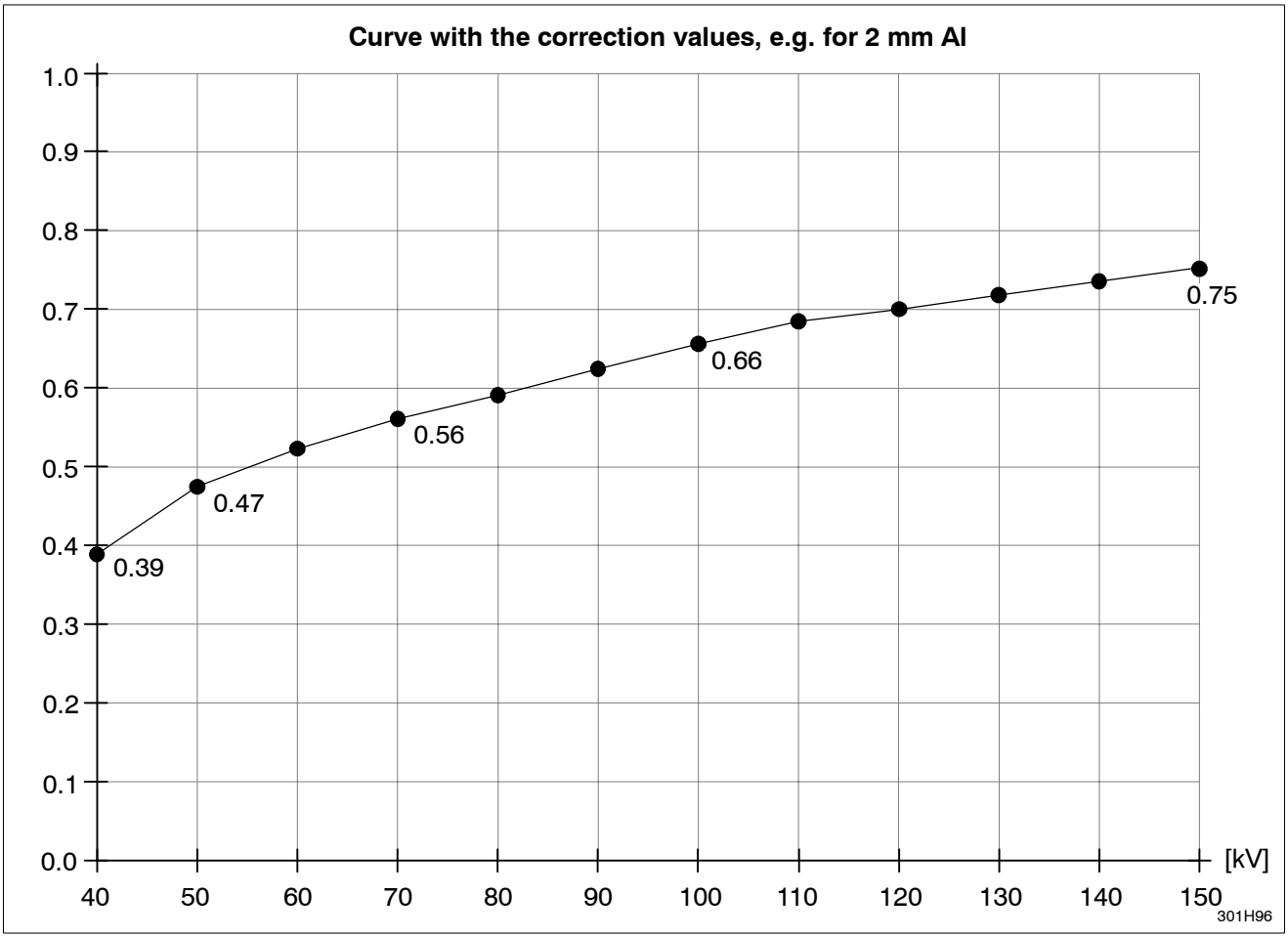
Filter correction – 1 mm Al + 0.1 Cu

kV-checkpoint	~~40~~	50	70	100	150
default factor	~~0.17~~	0.25	0.37	0.5	0.65
measured dose [µGy] without filter					
measured dose [µGy] with filter					
new factor	new factor = dose with filter / dose without filter				

Filter correction – 1 mm Al + 0.2 Cu

kV-checkpoint	~~40~~	50	70	100	150
default factor	~~0.064~~	0.123	0.23	0.37	0.53
measured dose [µGy] without filter					
measured dose [µGy] with filter					
new factor	new factor = dose with filter / dose without filter				



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- Read out the default values of the filter tables for each kV checkpoint, correct with the factor determined and write back into the generator with <Transmit>.

  Menu ***"Adjust/ Area Exposure Product/ Add Filter Correction Tables/...***

  ... 2 mm AL"

  ... 1 mm AL+0.1mm CU"

  ... 1 mm AL+0.2mm CU"
- Save the specific correction tables with the SAVE function of XRGSCOPE (F3 key) on the backup disk.

  Recommended file names:

  act_2al.tdl filter 2 mm Al

  act_01cu.tdl – filter 1 mm Al + 0.1 mm Cu

  act_02cu.tdl filter 1 mm Al + 0.2 mm Cu

2. Alignment of "Function Unit kV"

2.1. General

Printed-circuit boards kV_Control_3 and kV_Control_4 (EZ 130) must be aligned to the respective hardware used.

The alignment must be carried out when

- a new system is installed after tube adaptation has taken place and
- one of the following components is exchanged:
  - PCB Control 3 / 4 (EZ 130)
  - Converter EQ / E2Q
  - H.V. generator
  - PCB Central Unit (EZ 139).

In addition to this, the alignment must also be carried out in case of data loss in the NVRAM of the central unit (EZ 139) since the "Factor for duty cycle" is stored in this memory.

A control value of the kV control which corresponds to the pulse width is aligned. For this purpose the kV control must be switched off for otherwise the measurement might be faulty. Switch the kV control off and align to the mean value of U_{comp}. Also see sketch Z1–3.3 kV-control and sketch Adjustment U_{comp}.

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2.2. Connection/settings of the oscilloscope

Y1 to EZ 130 X26 : U_{comp} : 1V/div
Y2 to EZ 130 X3 : AVHT : 2V/div

Ground to EZ130 X6 : GNDA
for kV-control 3 ≤ 4512 108 09082
and kV-control 4 ≤ 4512 108 09103

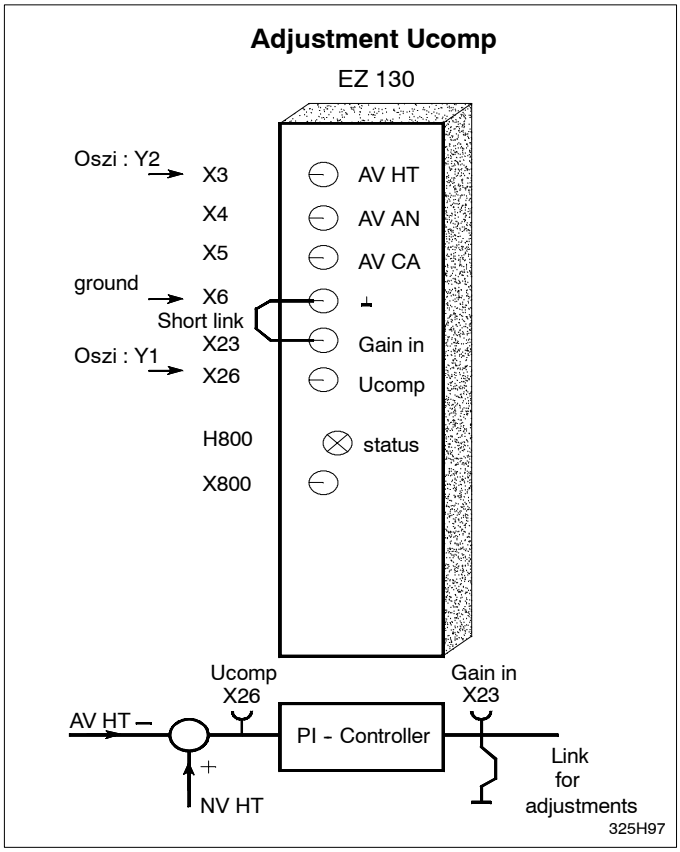
or

Ground to EZ130 X32 : GNDA
for kV-control 3 ≥ 4512 108 09083
and kV-control 4 ≥ 4512 108 09104

Time base: 5ms/div

Trigger: Y1 DC/negative edge/trigger level +3V
or (Y2/+DC)

Caution!
Ground of the digital oscilloscope must be separated from earth potential, i.e. use either
- a battery-powered oscilloscope
or
- an isolating transformer
for the oscilloscope.
Measurements without separation of the potential may cause measuring faults.



2.3. Deactivate the kV-controller

- Connect EZ 130 X23 GAIN_IN with X6 GNDA with a short link.

2.4. Exposure data

- Tube voltage : 141 kV
  If the tube is permitted only up to 125 kV, set 125 kV.
- Tube current : With single-converter generators : KV_3 : 100 mA
  With double-converter generators : KV_4 : 200 mA
- Exposure time : 40 ms

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2.5. Adjusting the ”Factor for duty cycle” with service software XRGSCOPE

- Connect the PC to X5 on EZ 139 Central Unit CU (see also “Fault finding”).
- Call the service program with XRGSCOPE.
- Select unit ↲
  FU-kV ↲
  Adjust ↲
  IGBT pulse width correction ↲
  Factor for duty cycle: 1.00 (Default value)

{F2} ↲. <Transmit>

After <Transmit> push the button of the RGDV selected for the alignment once.
This procedure validates the new transmitted duty cycle factor and transmits the new value to kV_control.
(One can also reboot the generator after transmit, but this procedure is much faster).

2.6. Measurements and alignments (see reference oscillograms)

Starting point: Factor for duty cycle default: 1.00

- Release an exposure.
  The values are measured in the stationary condition. The transient behavior is not taken into account.
  The mean value of U_{comp} must be:
  - PCB kV-control 3: U_{comp} = 1V + 1V/ - 0.5V
  - PCB kV-control 4: U_{comp} = 1V ± 0.5V.

  Then the peak value (not the overswing) of AVHT is about 138kV.
- Change the factor for duty cycle in steps of ±0.01 until the following values are obtained:
  - U_{comp} too high ==> Raise ”Factor for duty cycle”
  - U_{comp} too low ==> Reduce ”Factor for duty cycle”

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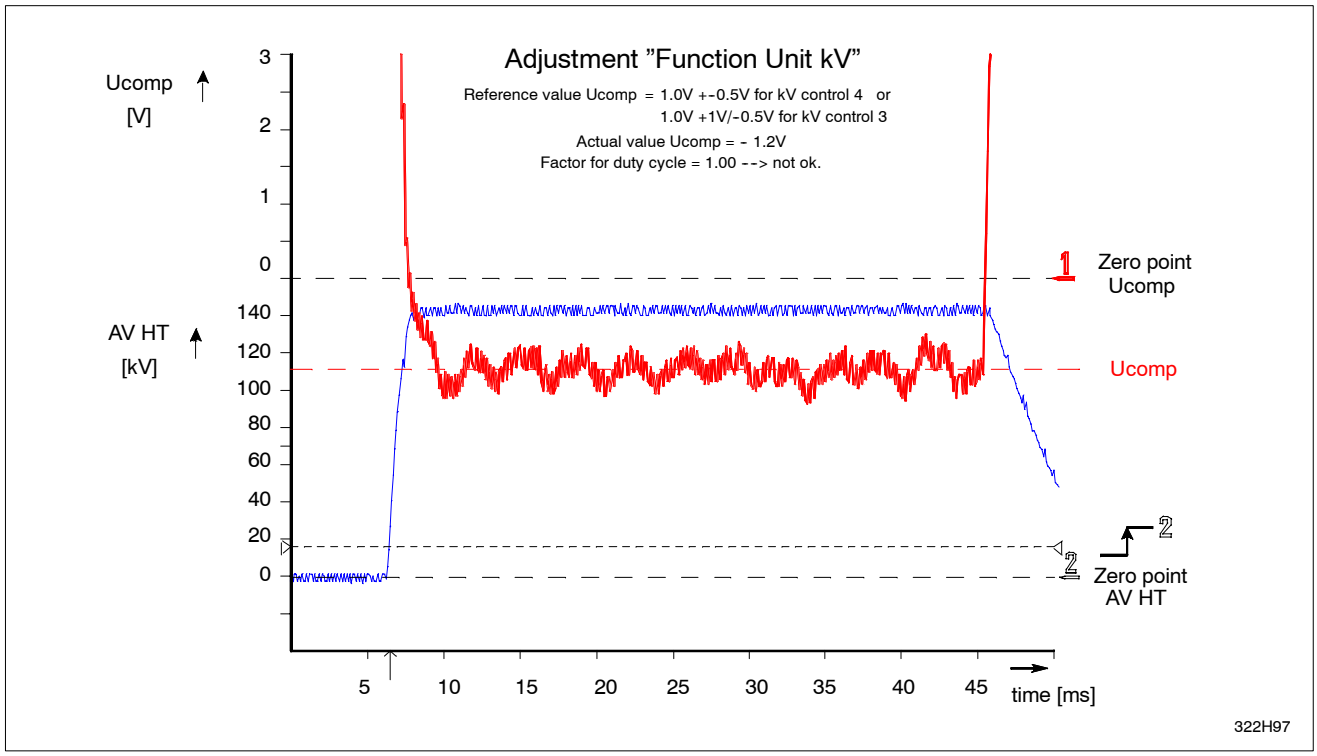
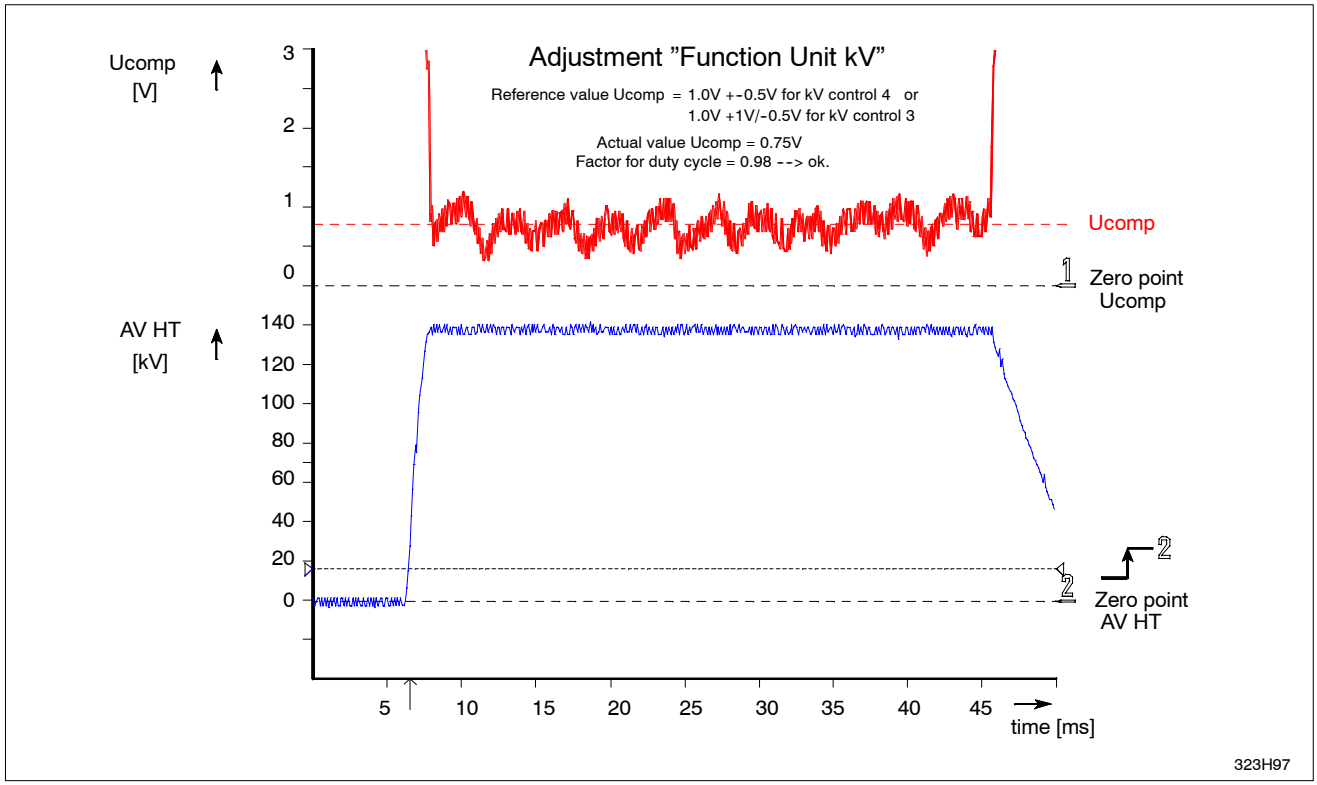
2.6.1. Reference oscillogram: Factor for duty cycle = 1.00

---> Alignment not correct:


Adjustment "Function Unit kV"
Reference value Ucomp = 1.0V +-0.5V for kV control 4 or
1.0V +1V/-0.5V for kV control 3
Actual value Ucomp = - 1.2V
Factor for duty cycle = 1.00 --> not ok.
Ucomp [V]
AV HT [kV]
Zero point Ucomp
Ucomp
Zero point AV HT
time [ms]
322H97

2.6.2. Reference oscillogram: Factor for duty cycle = 0.98

---> Alignment correct:


Adjustment "Function Unit kV"
Reference value Ucomp = 1.0V +-0.5V for kV control 4 or
1.0V +1V/-0.5V for kV control 3
Actual value Ucomp = 0.75V
Factor for duty cycle = 0.98 --> ok.
Ucomp [V]
AV HT [kV]
Ucomp
Zero point Ucomp
Zero point AV HT
time [ms]
323H97

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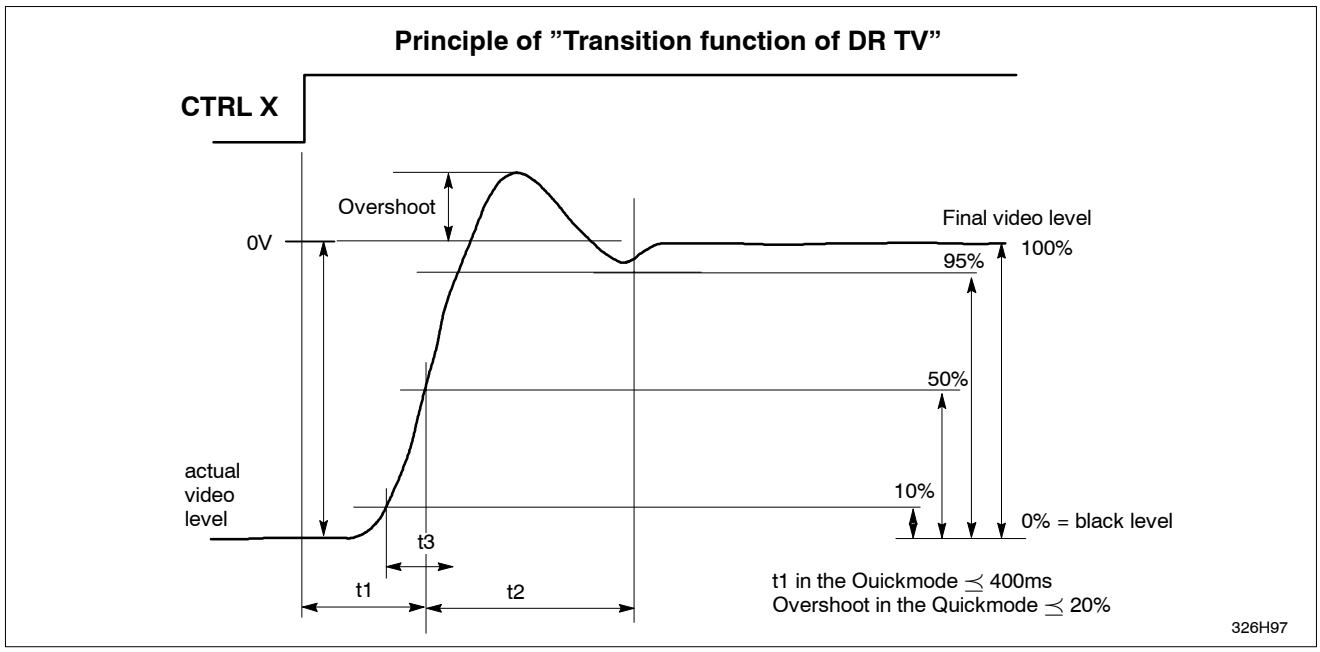
3. Dose rate alignment for continuous fluoroscopy when using the dose-rate signal DR TV (formerly ADC) // dose-rate control via TV-chain

3.1. Aim

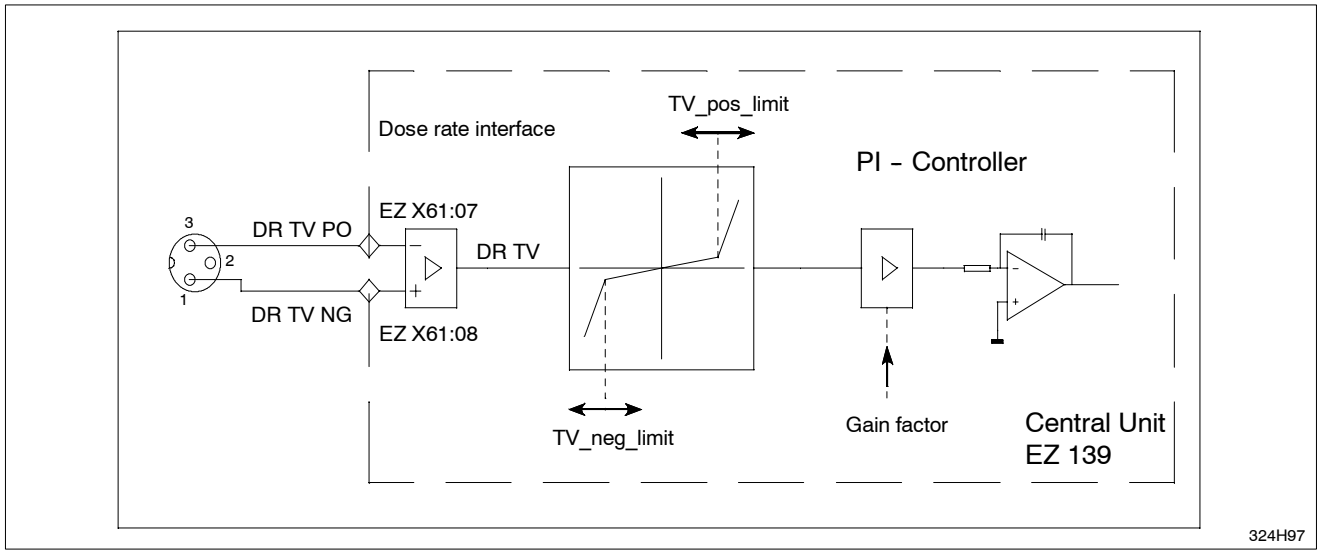
The amplification factor of the control circuit must be adjusted such that
- the TV image becomes visible within about 400 ms after fluoroscopy is switched on with RQXGFL,
- there is no flashing of the TV image (overshoot < 20%).

Also see sketch “Transition function of DR TV”.



3.2. Principle

Adjusting value : Transition function of DR TV
Variables : TV_pos_limit / TV_neg_limit / Gain factor



- Set the gain factor to default value = 1.00 with FW XRGSCOPE:

OPTIMUS
--> Adjustments
--> Dose rate control
--> Amplification gain
--> CONT **Gain factor 0.5...2 (default = 1): [1.000]**

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- With fluoroscopy **switched off**, measure the black level of the dose-rate signal of the TV chain.
  Suitable test points:
  - WN 25 DRDFP (with a TV chain XTV 11)
  - (EZ X61:7 = DR TV PO)

  The kink of the characteristic curve TV_pos_limit to be adjusted must be:
  TV_pos_limit = DR TV PO (black level measured) - 500 mV.

  Example: DR TV PO = 7.3 V → adjusting value TV_pos_limit = 6.8 V.

- Set TV_pos_limit via XRGSCOPE:

  OPTIMUS
  --> Program
  --> Dose rate control
  --> **CONT:**

Program settings for continuous fluoroscopy:

```
+ ---------- CONT_MOD.TDL ---------- +
| scantime_TV [ms]:   [ 20.000] |       → 50 Hz = 20ms
| scantime_TV valid:      Yes❑  |       → yes with control via TV chain.
|                               |         With photo diode = no.
| P_max_EDL [W]:       [  250]  |       → 250 default: Effective only when SID
|                               |         WB X12:1 DRLM is switched on.
| TV_pos_limit [V]:     [6.8]   |       → DR TV PO - 500 mV.
|                               |         (TV black voltage - about 500 mV)
| TV_neg_limit [V]:     [-6.8]  |       → = - TV_pos_limit [V]
| ------------------------------- |
|   < OK >                      |
| ------------------------------- |
```

In case the switch-on procedure is fast enough with this setting
T1 ≦ 400ms in quick mode or T1 ≦ 500 ms in normal mode
and the TV chain does not flash when fluoroscopy is switched on,
overshoot ≦ 20%
the alignment with the oscilloscope described below is **not** required.

3.3. Alignment of DR TV with the oscilloscope

Settings of the oscilloscope:

Y1	to EZ 150 X6	:	EN X C/	[10V / div]
Y2	e.g. with XTV11 to WN 25	:	DRDFP	[5V / div]
Ground	to EZ 150 X5	:	GNDA	
Time base		:	200 ms / div	
Trigger		:	Y1 / - DC	

The alignment should not be carried out in the quick mode since the differences of the transition functions are not big enough in the quick mode. However, in the normal mode the overshoot is slightly higher than 20 %.

Since fluoroscopy is automatically in the quick mode for up to 30 s after the end of fluoroscopy, after each oscillogram fluoroscopy must be switched off for at least 30 s:

Pause > 30s → Fluoro ON → Oscillogram → Fluoro OFF
→ Pause > 30s → Fluoro ON → Oscillogram → Fluoro OFF

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Fluoroscopy adjustments for all oscillograms:

- Dark voltage of the TV chain measured: DR TV PO $_{dark}$ = 7.3 V

XRGSCOPE:

OPTIMUS
--> Program
--> Dose rate control
--> **CONT:**

```
scantime_TV [ms]      :  20.000  (→ 50 Hz)
scantime_TV valid     :  Yes
P_max_EDL [W]         :  250
```

Operating point of fluoroscopy in the automatic mode (example XTV 11):

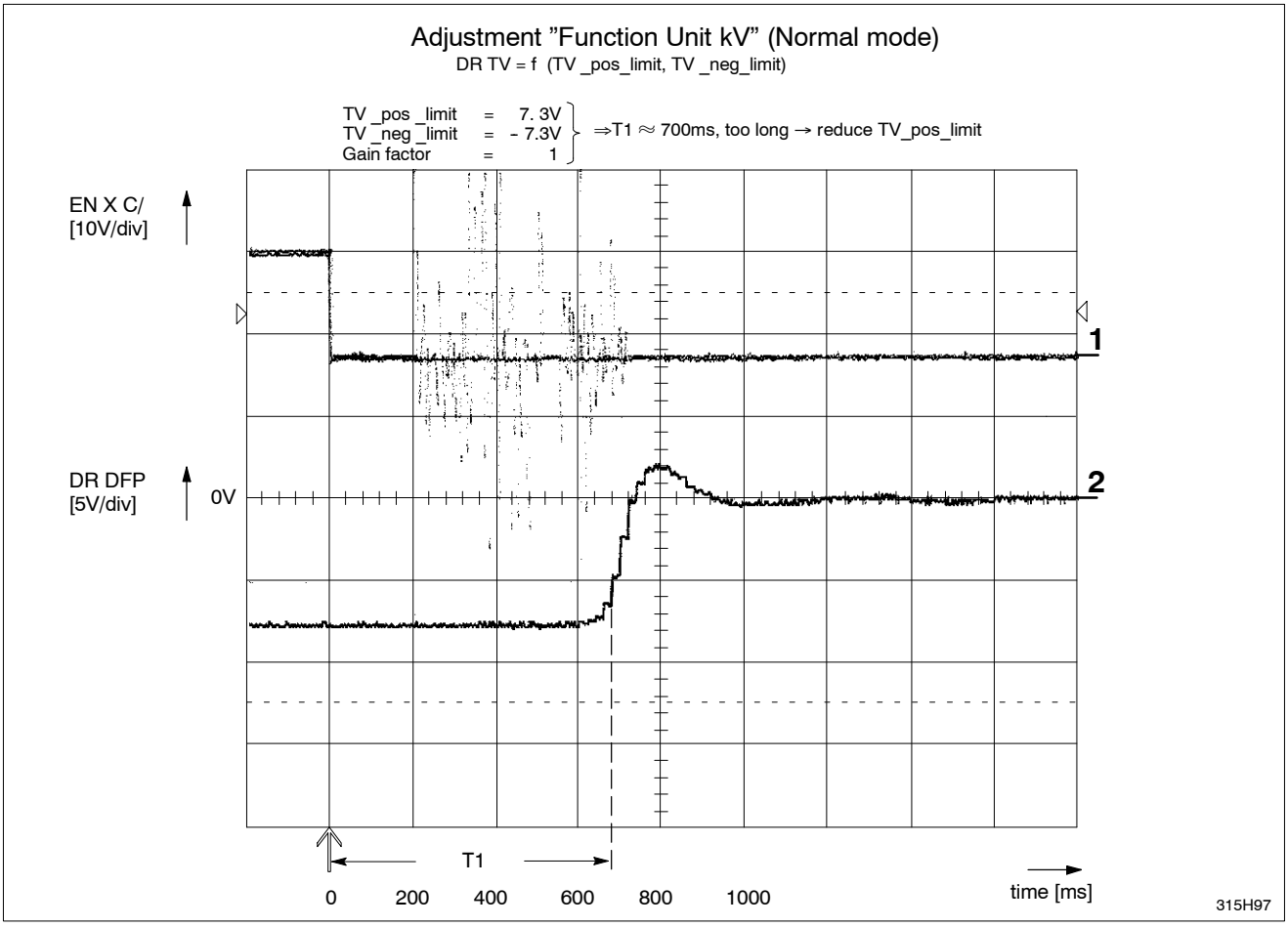
- 9" I.I. format
- Filter in the path of radiation: 1.5 mmCu + 20 mmAl ==> 74 kV/ 2.2 mA.

First reference oscillogram:

Values adjusted with XRGSCOPE:

```
- TV_pos_limit [V]   :  [ 7.3 ]
- TV_neg_limit [V]   :  [ -7.3 ]
- Gain factor        :  [ 1.00 ]
```

} ==> T1 ≈ 700 ms --> too long --> reduce TV_pos_limit [V]



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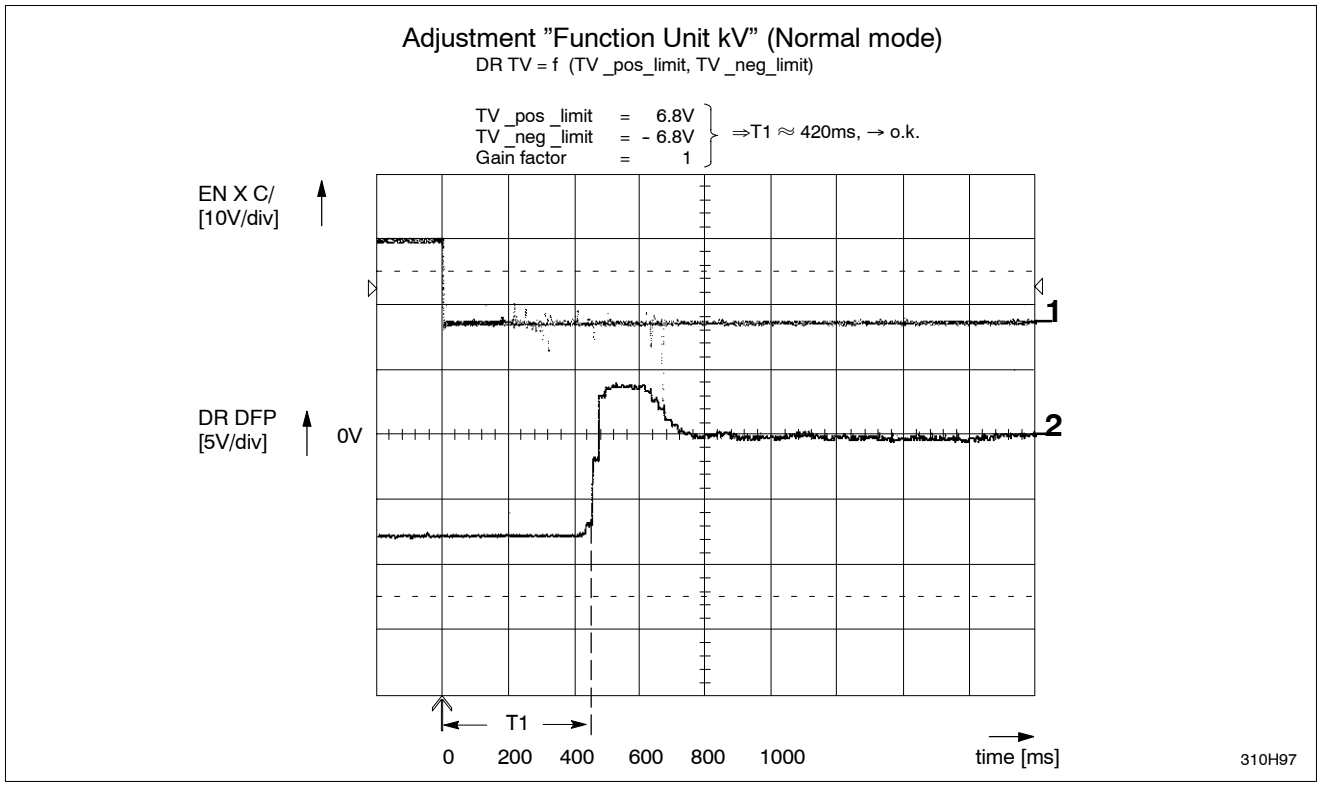
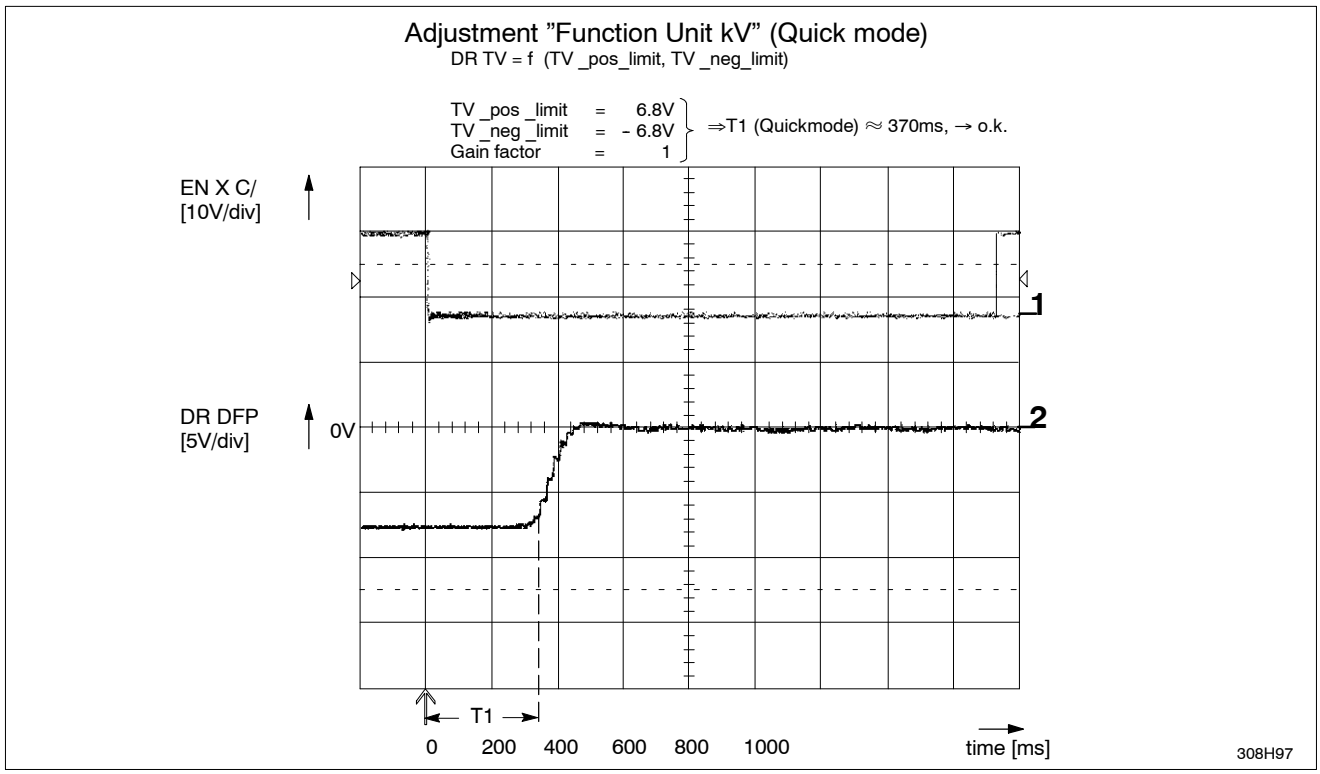
Second reference oscillogram:

Values adjusted with XRGSCOPE:

- TV_pos_limit [V] : [6.8]
- TV_neg_limit [V] : [-6.8]
- Gain factor : [1.00]

} ==> T1 ≈ 420 ms --> o.k.
and gain factor can remain as they are





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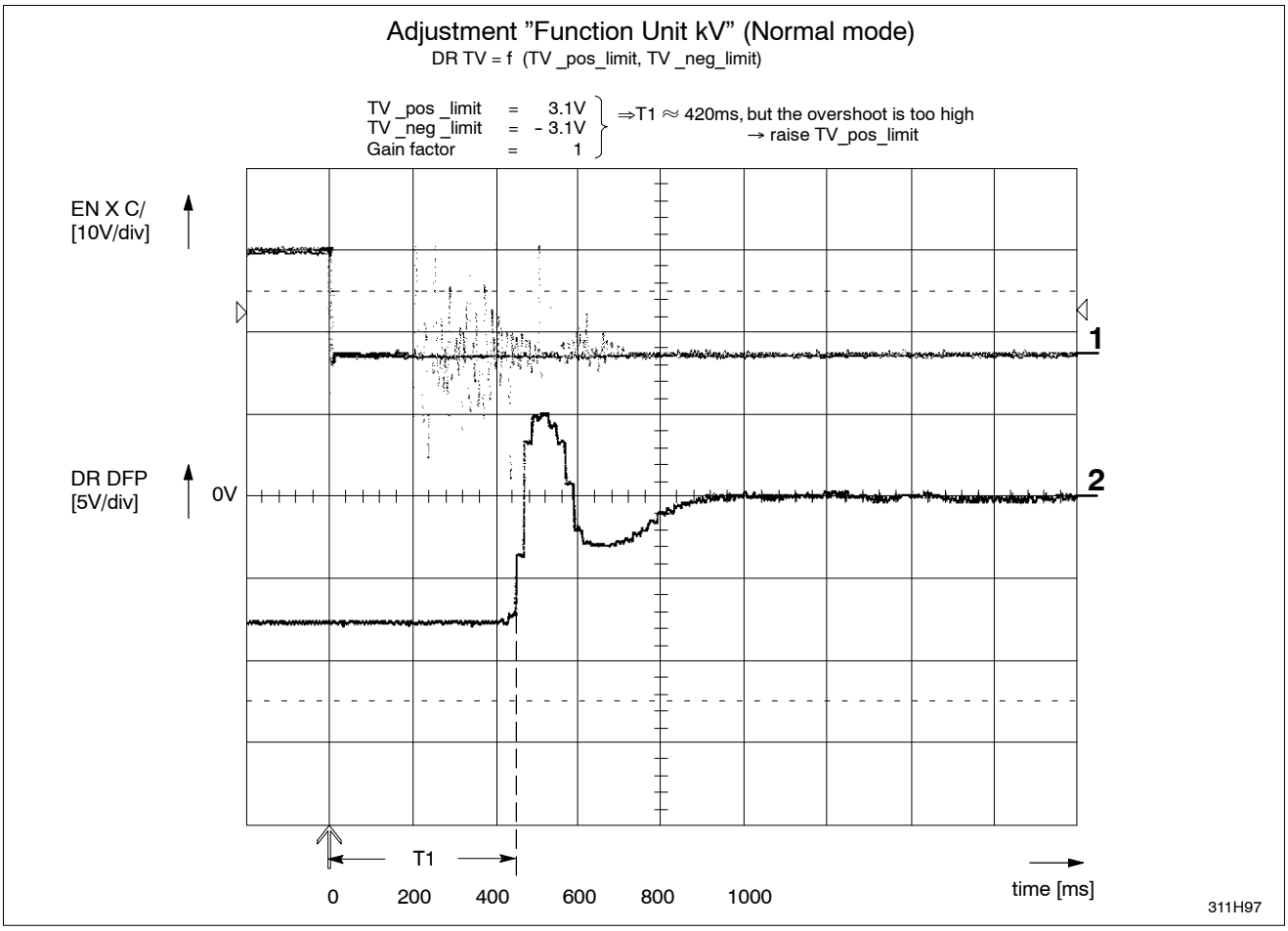
Third reference oscillogram:

Values adjusted with XRGSCOPE:

- `TV_pos_limit [V] : [ 3.1 ]`
- `TV_neg_limit [V] : [ -3.1 ]`
- `Gain factor : [ 1.00 ]`

==> T1 ≈ 420 ms --> o.k., but the overshoot is too high
The TV image flashes!
--> Raise TV_pos_limit [V]



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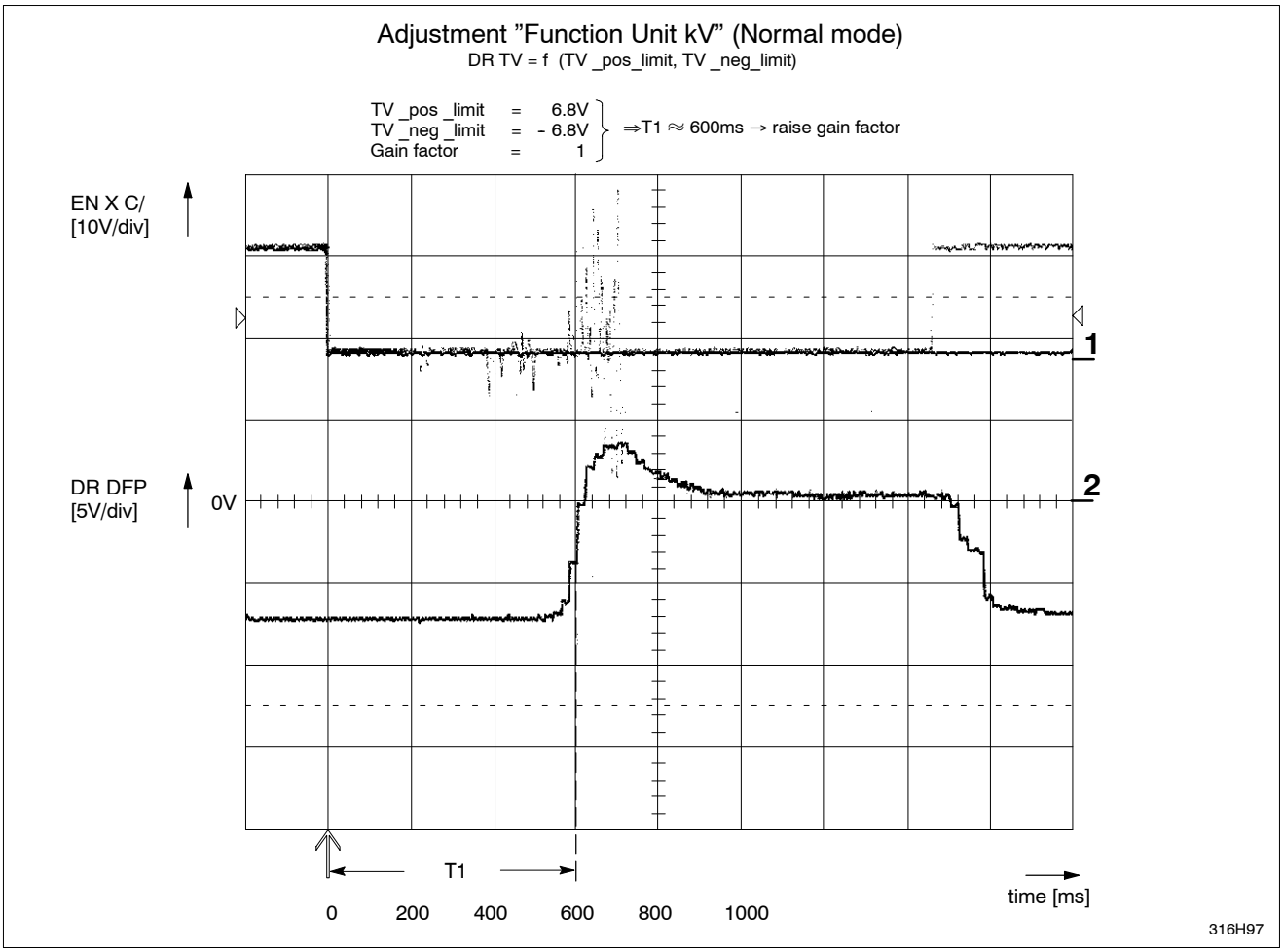
Forth reference oscillogram:

Values adjusted with XRGSCOPE:

- TV_pos_limit [V] : [6.8]
- TV_neg_limit [V] : [-6.8]
- Gain factor : [0.50]

} ==> T1 ≈ 600 ms --> too long --> Raise gain factor to 1.00!



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4. Maximum patient entrance dose rate Entrance Dose rate Limiter (EDL)

4.1. Aim

In some countries the maximum patient entrance dose rate must be limited to comply with the respective national regulations, for instance 10 R/min. = 1.4567 μGy/s in the USA.

4.2. Principle

The maximum patient entrance dose is measured with maximum kV. By reducing the maximum power P_max_EDL provided by the generator, the dose rate is reduced until it complies with the national regulations or the individual wish of the user.

Note
*The dose rate reduction programmed via P_max_EDL is effective only when the SID contact (**S**ource **I**mage **D**istance) is switched on: WB X12:1 DRLM → closed!*

4.3. Alignment

- Cover the I.I. with lead such that with fluoroscopy maximum kV (110kV) are adjusted (protection of the I.I. against excessive radiation).
- Adjust the exam./aux. unit in such a way that the SID contact is closed.
  If necessary, place a shorting plug on decade WB X12:1 ---- X12:10 (ground).
- Adjust the exam./aux. unit in such a way that the smallest distance between tube and patient is effective.
- Position the dose rate measuring chamber in such a way that it is at the same height where the radiation would enter the patient.
- Switch on fluoroscopy.
- Reduce/raise **P_max_EDL [W]** with the service software XRGSCOPE until the dose rate is identical with the maximum permissible value:

  XRGSCOPE OPTIMUS
  --> Program
  --> Dose rate control
  --> **CONT:**

```
+ ---------- CONT_MOD.TDL ---------- +
| scantime_TV [ms]:   [ 20.000]      |
| scantime_TV valid:      Yes        |
|                                    |
| P_max_EDL [W]:       [ nnn]        |
|                                    |
| TV_pos_limit [V]:     [6.8]        |
|                                    |
| TV_neg_limit [V]:     [-6.8]       |
| ---------------------------------- |
|   < OK >                           |
| ---------------------------------- |
```

Range: 0 ... 9000 W (250 default)
→ Effective only when SID contact WB X12:1 DRLM is switched on.

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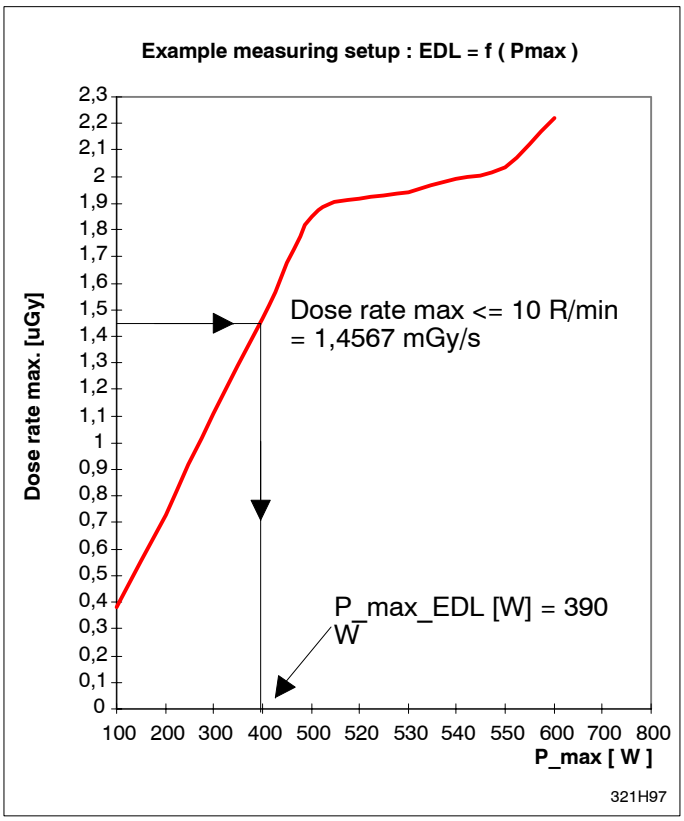
- Note the measuring values:

P_max_EDL: [W]														
Dose rate: [µGy/s]														

Example of a measuring setup:



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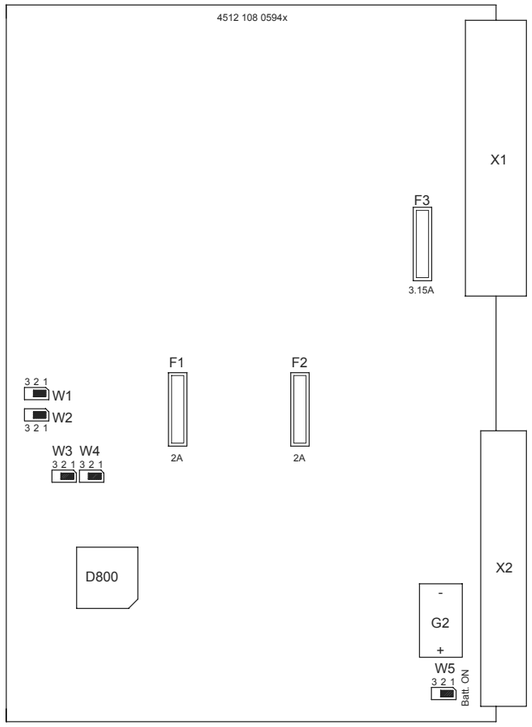
EZ 119 mA control



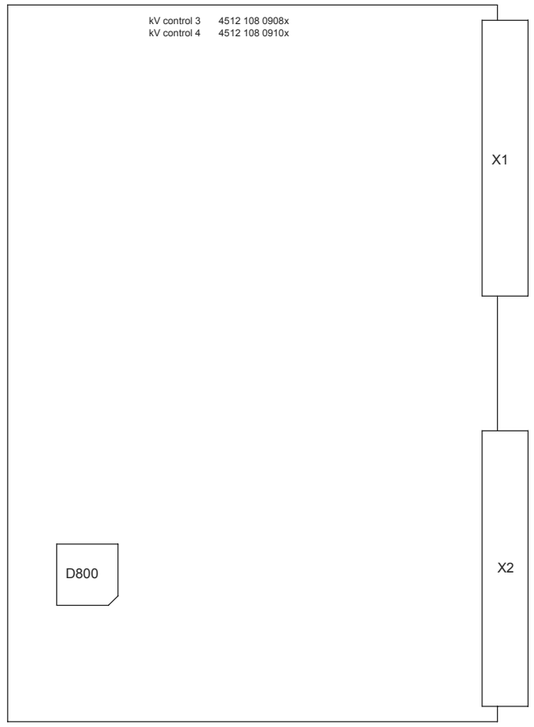
D800 = 4512 113 20211 (4512 114 20211)

= 4512 113 20212 (4512 114 20212)

Attention: Do not forget to set the jumper of the battery in the position "Batt. ON":

EZ119: W5
EZ139: W1

EZ 130 kV control 3/4



D800 = 4512 113 20121
D800 = 4512 113 26201 only for 50kW R/F

kV control 3 ≥ 4512 108 09081
kV control 4 ≥ 4512 108 09101

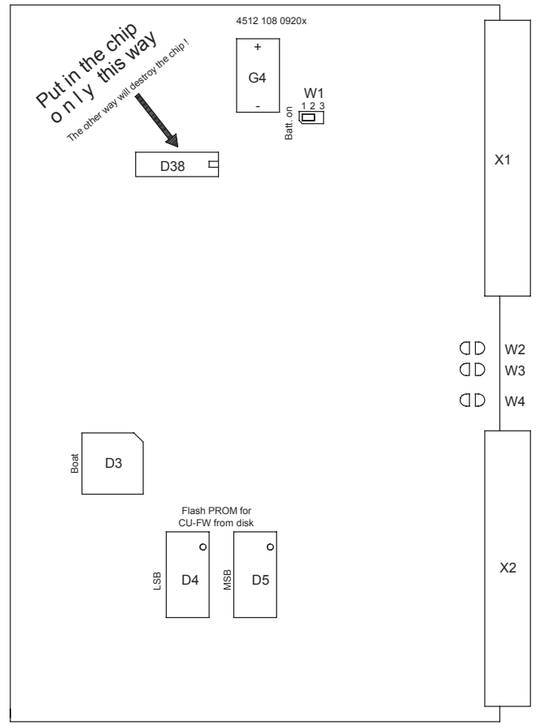
- OPTIMUS R/F
- OPTIMUS C

D800 = 4512 113 26211
= 4512 113 26212

- OPTIMUS RAD

D800 = 4512 113 20131
= 4512 113 20132

EZ 139 Central unit



D38 = function key, marked with s/n of the generator

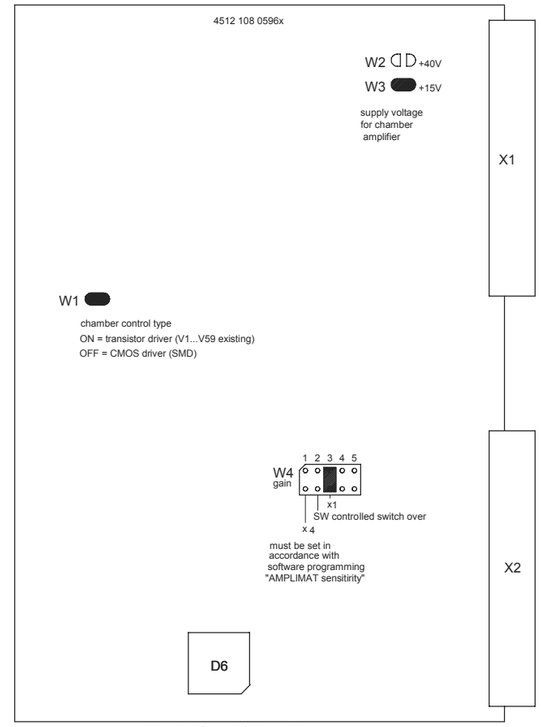
OPTIMUS R/F :
OPTIMUS RAD :

Boot- FW D3 = 4512 113 20731 (4512 114 20731)
Cu - FW Rel 3 = 9890 000 02511 (4512 114 2083x)

OPTIMUS C :

Boot- FW D3 = 4512 113 27001 (4512 114 20001)
Cu - FW Rel 1 = 9890 000 02541 (4512 114 26901)

EZ 150 Basic interface



W1...W4 from PCB level 4 onwards

D6 = 4512 113 20311 (4512 114 20311)

= 4512 114 25801

for Low Speed Rotor control TS 9890 000 0226.
and for
XSTAR low speed Rotor control 9890 000 0228.

A1/A3 99-11-09 Schr./Kö

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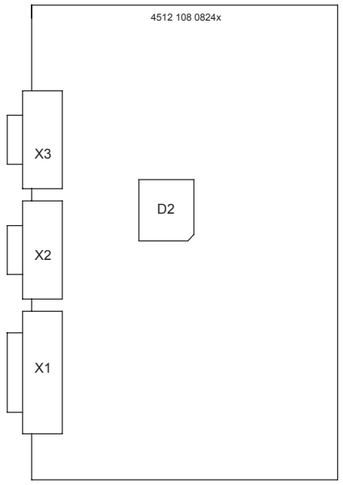
Operating desk C 1)

C 300 CPU

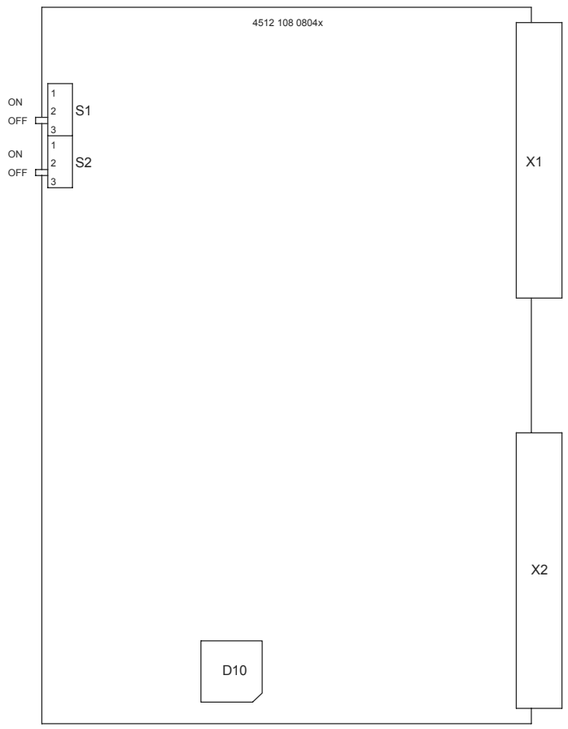


1) not for OPTIMUS C

D2 = 4512 113 20521 (4512 114 20521)
= 4512 113 20522 (4512 114 20522)
= 4512 113 20523 (4512 114 20523)
= 4512 113 20524 (4512 114 20524)

Adapter decade cable WA, 1WA, 2WA, 1WB 1)

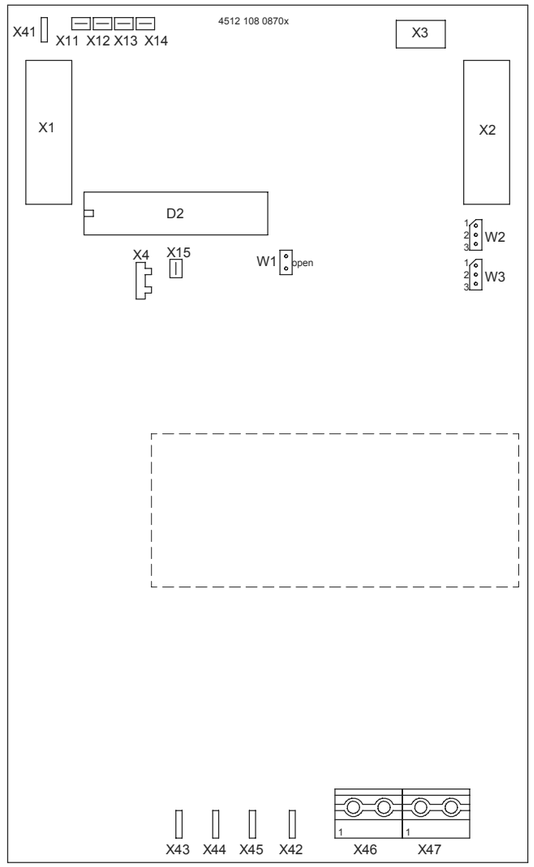
WB/WA 102 Universal I/O interface



D10 = 4512 113 20611 (4512 114 20611)

Dual speed rotor control Y 9890 000 0221x
RO Duo speed rotor control Y 9890 000 02661

Y 100 Roco HS

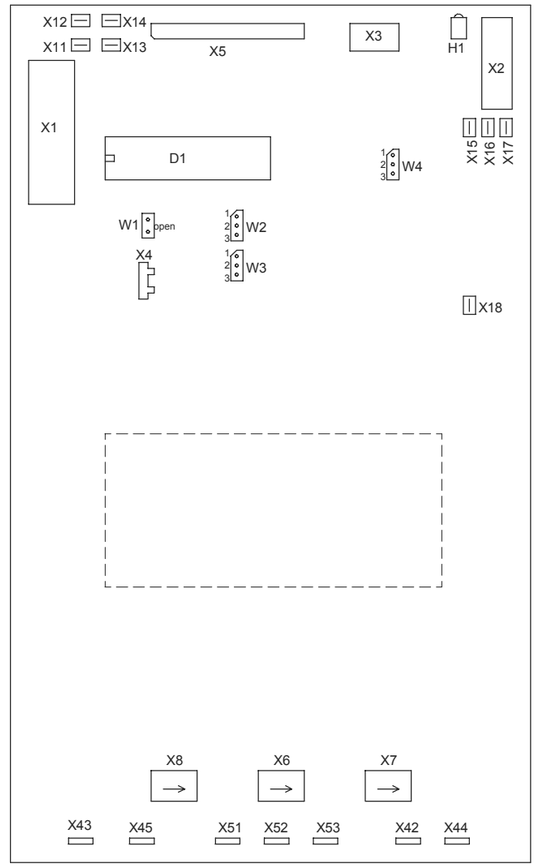


Coding	Rotor control 1st	Rotor control 2nd
W2	1 2 3	
W3	1 2 3	

D2 = 4512 113 22311 (4512 114 22311)
= 4512 113 22312 (4512 114 22312)

Ro Dual speed rotor control Y 9890 000 02662
Dual speed rotor control OPTIMUS Y 9890 000 0268x

Y 100 Roco HS 4512 108 0974x



Coding	Rotor control 1st	Rotor control 2nd
W2	1 2 3	
W3	1 2 3	

W4	Application of RoCo HS
1 O 2 O open 3 O	normal
1 O 2 O ⌐ 2 - 3 closed 3 O ⌐	MRC solo

D1 = 4512 113 22321/2 (4512 114 22321/2)

A1/A3 99-06-09 Schr.

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PCB programming
Options